2009

# Report of the Fraser River Panel to the Pacific Salmon Commission on the 2009 Fraser River Sockeye and Pink Salmon Fishing Season

*Prepared by the*

**Pacific Salmon Commission**

**January 2015**

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# In Memoriam

## Thomas David Bird
### 1938 – 2010

Thomas David Bird, resident of Bowser, passed suddenly on February 16, 2010 at St. Joseph's Hospital, Comox, BC. Born on November 17, 1938 in Vancouver to Owen William Bird and Jean Margaret Bird, both deceased, Tom was survived by his wife , Carol, son Owen, daughter-in-law Allison, grandson Thomas (Will) and Max, his dog. Raised in Golden and Vancouver by a father who loved fishing and hunting (and a supportive mother willing to indulge these pursuits), those formative years indelibly affected Tom's interests. Tom's family was deeply influenced by his great love for the outdoors and had many fond memories of the "one more cast, one more pass, one more flight" syndrome of tardiness for dinners and appointments over the years. A more recently acquired passion for golf was shared with Carol and suited Tom's social ease and interest in a challenge. And for all of his joy and enthusiasm for the outdoors, Tom's work life was always encouraged and supported by his family. Tom was committed to preserving our fish and wildlife heritage for the future from an early age, and to that end he directed his life to the field of fish biology. After earning a degree in biology from Rocky Mountain College in Billings, and meeting his future wife there, Tom returned to BC with Carol and began his career with the then Federal Fisheries Department in the mid 1960's. He spent his early years in a host of positions around the province and on the high seas assisting in the research of the movement of our salmon stocks. Tom then moved into the Habitat Management branch of Fisheries and made many contributions to habitat protection in his years, including playing a pivotal role in the development of Canada's "no net loss" policy as it pertains to fish habitat. He eventually rose to the position of Director of the Habitat Branch. In 1989 he was appointed Regional Chief of Recreational Fisheries. Tom, as he had done in the Habitat Branch, built a strong team of dedicated individuals and together they brought recreational fishing into the forefront of the management thinking of DFO. Under Tom's guidance, the Sport Fishing Advisory Board expanded from a centralized body to one with bases in the local communities and which allowed full input into the advisory process for anglers from all parts of B.C. Today the SFAB is recognized worldwide as the ultimate in workable advisory processes and one that has credibility with government and at the community level. In 1997, Tom retired from the DFO but not from his commitment to fish and the fishery, and he took over the reins of the Sport Fishing Institute of British Columbia as Executive Director. Under his leadership, this organization became a most effective voice in the management of the fishing tourism business in British Columbia and Canada. At the time of his death, Tom was still involved in this organization as a member of the Board of Directors after he stepped down as the Executive Director. From 2003 until his passing, Tom was Canada's Recreational Fishing representative on the Fraser Panel of the Pacific Salmon Commission where he has served with distinction. Acquaintances and co-workers who became lifelong friends sorely miss this man who was truly "one of a kind". Tom was a family man and dedicated father, hunting trips to the prairies and fishing Haida Gwaii were favourite family activities. Ready to wet a line at a moment's notice and to share his love for the outdoors, Tom was always watching the waters off of Bowser for a telling fin or swirl. Movies, sports of all kinds and a love of books filled his time away from the water as well as the golf course, ski hill or work. As "Pop Pop" to Will, Tom began imparting his passion, knowledge and love of the outdoors to his young grandson with walks to the river, tidal pool exploring on the beaches at Bowser and also by simply being with him and laughing together. Most importantly, however, his family and friends admired his unwavering love and affection for his best friend who he affectionately referred to as "Carolena".

# REPORT OF THE
# FRASER RIVER PANEL
# TO THE PACIFIC SALMON COMMISSION
# ON THE 2009 FRASER RIVER SOCKEYE AND PINK SALMON FISHING SEASON

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**PACIFIC SALMON COMMISSION**

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# I. EXECUTIVE SUMMARY

## Pre-season Planning

1. Pre-season expectations for Fraser River sockeye salmon included a total abundance of 10,488,000 fish and Johnstone Strait diversion rate of 32%. Pre-season planning was based on the 75p-level abundance forecast for Early Stuart sockeye and 50p-level (median) forecasts for all other groups. Forecast abundances and expected Area 20 50% migration dates by management group were: Early Stuart - 165,000 (July 2); Early Summer – 739,000 (July 26); Summer – 8,677,000 (August 5); Birkenhead – 334,000 (August 11); and Late – 573,000 (August 11) (Table 1).
2. Pre-season spawning escapement goals as established by Canada's spawning escapement plan (Appendix A) were abundance based. At the pre-season forecasts noted above they were 156,000 Early Stuart, 296,000 Early Summer, 3,471,000 Summer and 134,000 Birkenhead sockeye. In addition, Management Adjustments (MAs) of 72,000 Early Stuart and 118,000 Early Summer fish were added to the spawning escapement targets to increase the likelihood of achieving the targets. The MAs were based on relationships between river conditions (discharge and temperature) as they relate to historic differences between lower river and upriver escapement estimates.
3. For Late-run sockeye, the Panel assumed a continuation of the early upstream migration behaviour and associated high mortality that has occurred since 1996. Given pre-season assumptions about marine timing and recent delay behaviour, the median upstream migration date for Late-run sockeye was expected to occur during the third week of August. Based on this upstream timing and the 50p abundance forecast the Panel adopted an allowable exploitation rate of 20%.
4. The projected Total Allowable Catch of Fraser River sockeye salmon (Table 1) was 5,394,000 sockeye, of which 16.5% were allocated to the United States (U.S.).
5. Pre-season expectations for Fraser River pink salmon were for an abundance of 17,535,000 fish, a Johnstone Strait diversion rate of 40% (revised in-season to 47% based on a DFO forecast) and an Area 20 50% migration date of August 25. With a spawning escapement target of 6,000,000 fish the TAC was 11,525,000 pink salmon, of which 25.7% were allocated to the U.S.
6. Pre-season modeling indicated it was unlikely the Total Allowable Catches (TACs) of Summer-run sockeye and Fraser pink salmon could be harvested, due to constraints required to achieve the escapement targets for co-migrating Early Summer and Late-run sockeye.
7. The Panel adopted a management plan and fishery regime before the fishing season, including the "Principles and Constraints", "Guidelines to Address Late Run Concerns" and "2009 Regulations" (Appendices C, D and E).

## In-season Management Considerations

8. The final in-season run-size estimate of 1,370,000 sockeye was only 13% of the median forecast abundance, the lowest return on the 2009 cycle since records began in the late 1800s and the lowest on any cycle since 1947. In particular, the stocks that were expected to contribute the most to abundance and catch, Chilko and Quesnel, returned at only 7% of the median forecast. As a result, there were no sockeye-directed commercial fisheries in either Canada or the U.S., and First Nations sockeye fisheries were severely constrained.
9. The return of Fraser pink salmon exceeded the median forecast and provided opportunities for pink-directed fisheries in both countries. Sockeye by-catch in these fisheries was minimized by waiting until most sockeye had cleared fishing areas and by implementing regulations that stipulated non-retention of sockeye.
10. River temperatures were warmer than average throughout the season, but particularly during late July and early August when temperatures exceeded 19°C for almost two weeks, peaking at 21°C on August 3 (Figure 6).

## Run Size, Catch and Escapement

11. The post-season estimate of adult Fraser sockeye returns totalled 1,590,000 fish (Tables 8 and 9), only 23% of the brood year abundance of 7,024,000 adults in 2005. Divided into management groups, adult returns totalled 82,000 Early Stuart, 178,000 Early Summer, 671,000 Summer, 72,000 Birkenhead and 588,000 Late-run sockeye. Returns of all management groups were poor, but Summer-run stocks were particularly affected. The smolt-to-adult survival rate of Chilko sockeye was only 0.3%, well below the previously observed record low of 1.2% in 2007.
12. As a consequence of the extremely poor sockeye return, Canada established a formal "Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River", otherwise known as the Cohen Commission[11], and the PSC organized a workshop where reasons for the decline were examined by an Advisory Panel made up of fisheries experts[12]. The Expert Advisory Panel's main conclusion was that the poor survival of the cohort that returned in 2009 was likely due to unfavorable oceanographic conditions (physical and biological) in the Strait of Georgia during the juvenile life stage of Fraser sockeye, and that such conditions are likely the major cause of the decreased productivity observed for most Fraser sockeye stocks over the last two decades.
13. Catches of Fraser River sockeye salmon in all fisheries totalled 123,000 fish, including 74,000 fish caught by Canada, 17,000 fish by the U.S. and 32,000 fish by test fisheries (Table 8). Almost all of the Canadian catch occurred in First Nations fisheries. In Washington, Treaty Indian fishers caught 4,300 sockeye (used for Ceremonial and Subsistence purposes) as by-catch in pink-directed fisheries. Fisheries in Alaska harvested 13,000 Fraser sockeye. The overall harvest rate was 8% of the run, which is the lowest on record (Figure 9).
14. DFO's near-final estimates of spawning escapements to streams in the Fraser River watershed totalled 1,056,000 adult sockeye (Tables 8 and 9). This was only 32% of the brood year escapement of 3,308,000 adults but similar to cycle line escapements in the 1949-1981 period (Figure 11). By management group and for this cycle line, spawning escapements in 2009 were the lowest to the Early Stuart system since 1965, lowest Early Summer escapement since 1997, lowest Summer-run escapement since 1949, similar to the last three cycle years for Birkenhead sockeye and second largest Late-run escapement on record (surpassed only by the brood year escapement). Included in the Late run was the Harrison stock with a spawning estimate of 309,000 adults, the second largest of any year on record and exceeded only by the brood year escapement in 2005. There were 514,000 effective female spawners in the Fraser watershed, representing an overall spawning success of 96%.
15. The in-season run-size estimate for Fraser pink salmon was 19,500,000 fish. This estimate was revised post-season to 19,993,000 fish, 14% larger than the median forecast and the 4$^{th}$ largest since at least 1959. Advancements in the PSC's hydroacoustic program made 2009 the first year in which direct in-river estimates of pink salmon migration past Mission was possible. The post-season run-size estimate was calculated by adding the total catch of Fraser pink salmon below Mission (3,842,000 fish) to the Mission passage estimate (16,152,000 fish). Spawning escapement (15,429,000 fish) was estimated by subtracting the total catch in all fisheries from the run-size estimate.
16. Catches of Fraser River pink salmon totalled 4,564,000 fish, with 1,727,000 caught by Canada, 2,816,000 by the U.S. and 22,000 in test fisheries. This catch represents an exploitation rate of 23% which is the largest since 1997, both in numerical and percentage terms.
17. The annual diversion rate through Johnstone Strait was 47% for Fraser sockeye and 37% for Fraser pink salmon.

## Achievement of Objectives

18. In order of descending priority, the goals of the Panel are to achieve the targets for spawning escapement, international sharing of the TAC and domestic catch allocation.
19. In-season management decisions are based on targets for spawning escapement, which are represented in-season by potential spawning escapement targets (i.e., spawning escapement targets plus MAs). In-season estimates of potential escapement (i.e., Mission escapement minus First Nations and recreational catches above Mission) approached or were higher than the targets for Early Stuart (11% under), Early Summer (1% over), Summer (10% under), Birkenhead (40% over) and Late-run (9% over) sockeye (Table 12). These results demonstrate that the Panel responded quickly to in-season indications of low sockeye abundance by maintaining complete closures on all sockeye-directed fisheries under Panel management.
20. Spawning ground estimates of sockeye abundance were 21% less than the post-season escapement target (1,337,000 spawners, Table 13). Spawner abundances were below the targets for Early Stuart (45% under), Early Summer (48% under) and Late-run (25% under) management groups, and close to or above the targets for Summer (8% under) and Birkenhead (13% over) groups. For the early groups this result is largely due to the magnitude of the observed differences between in-season and post-season escapement estimates (i.e., %DBEs) – given the observed run sizes and %DBEs, the spawning escapement targets could not be achieved even in the absence of any fishery catch.
21. The exploitation rate for Late-run sockeye (including Cultus) was only 3%, well below the 20% limit for this group (Table 14). Late-run sockeye are the index group used to estimate the exploitation rate on Cultus sockeye.
22. Based on the TAC calculation method set out in Annex IV, Chapter 4 of the Pacific Salmon Treaty and the February 15, 2008 Commission Guidance to the Fraser River Panel, the Fraser sockeye TAC was zero and thus the U.S. catch exceeded their share (Table 15). In this calculation, the allowable catch is fixed on the date that Panel control of the last U.S. Panel Area was relinquished (October 3 in 2009), while catches are the post-season accounted totals. The small overage of 4,300 sockeye in the U.S. (Washington) was a result of incidental sockeye catch in pink-directed Treaty Indian fisheries.
23. There was no commercial catch of Fraser sockeye salmon in Canada, and thus no impact on Canadian commercial fishery allocations. In the U.S., there were no commercial sockeye-directed fisheries and the only landings were the Treaty Indian Ceremonial and Subsistence (C&S) catch of 4,300 sockeye noted in the previous item.
24. Because catches of Fraser pink salmon were constrained by conservation measures necessary to protect Late-run sockeye, the spawning escapement target for Fraser pink salmon was exceeded by 9,429,000 fish (Table 13). The U.S. catch was 648,000 fish less and the Canadian catch 8,300,000 fish less than their respective shares of the TAC (Table 15). Treaty Indian fishers caught 700,000 fish less and All Citizen fishers caught 51,000 fish more than their share of the U.S. TAC. Among the Canadian commercial fleet, Area B seines were 265,000 over their share while Area D gillnets were 36,000 under, Area E gillnets were 60,000 under, Area G trollers were 60,000 under and Area H trollers were 110,000 under their respective allocations.
25. By-catches of non-Fraser sockeye and pink salmon in commercial net fisheries regulated by the Fraser River Panel totalled 0 sockeye and 962,000 pink salmon in 2009 (Table 18). Catches of other Fraser and non-Fraser salmon species included 980 chinook, 4,900 coho, 81 chum and no steelhead.

## Allocation Status

26. The U.S. owes a payback of 4,300 Fraser sockeye to Canada in future years (Table 19). There are no paybacks due for Fraser River pink salmon.

# II. FRASER RIVER PANEL

In 2009, the Panel operated under the terms of Annex IV, Chapter 4 of the Pacific Salmon Treaty between Canada and the United States (U.S.) [1] and the February 2008 "Commission Guidance to the Fraser River Panel" [2]. The Fraser River Panel is responsible for in-season management of fisheries that target Fraser River sockeye and pink salmon within the Panel Area (Figure 1), including net fisheries in both countries and the Canadian troll fishery in the Strait of Georgia. Coordination of directed harvest of other salmon species and stocks intercepted in south coast areas is the responsibility of the Southern Panel and the Pacific Salmon Commission (PSC). Regulation of Southern Panel related fisheries is the responsibility of the appropriate agencies in each country.

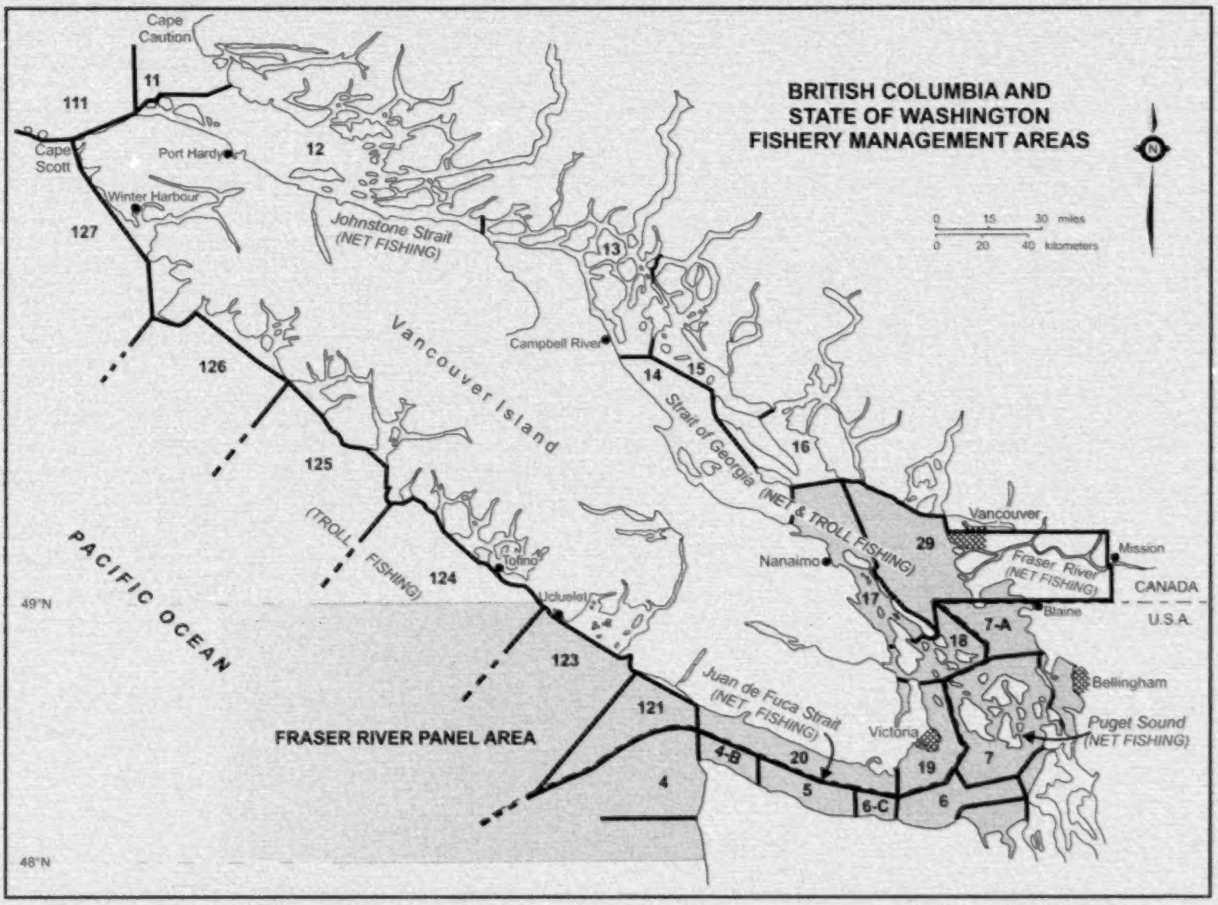


**Figure 1.** Fishery management areas in the Fraser River Panel Area and south coast waters.

Prior to the fishing season, the Fraser River Panel recommends a fishery regime for Panel Area fisheries to the Pacific Salmon Commission (PSC). The recommendation is based on: (1) abundance, timing and migration route forecasts and escapement targets for Fraser River sockeye and pink salmon provided by Canada's Department of Fisheries and Oceans (DFO); (2) international catch allocation goals set by the Treaty; (3) domestic catch allocation goals established by each country; (4) management concerns for other stocks and species also identified by each country; and (5) historic patterns in migration and fisheries dynamics. In descending

[1] Pacific Salmon Commission. 2009. Report of the Fraser River Panel to the Pacific Salmon Commission on the 2005 Fraser River sockeye and pink salmon fishing season. Appendix A. Vancouver, B.C.
[2] Pacific Salmon Commission. 2012. Report of the Fraser River Panel to the Pacific Salmon Commission on the 2008 Fraser River sockeye salmon fishing season. Appendix C. Vancouver, B.C.

priority, the objectives that guide the Panel's decision-making are to: (1) achieve the spawning escapement targets, (2) meet international catch allocation goals, and (3) meet domestic catch allocation objectives. Conservation concerns for other species and stocks that may occur as by-catch in fisheries directed at Fraser sockeye and pink salmon are generally addressed domestically with some international coordination.

Implicit to the management of all Panel-regulated fisheries is the principle that fisheries are to remain closed (Regulations, Appendix E) unless opened by specific order (In-season Orders, Appendix F). The management plan identifies the approximate pattern of fishery openings required to achieve Panel objectives given pre-season expectations. However, the Panel typically determines the actual pattern of fishery openings based on in-season assessments by PSC staff (Staff, Appendix J) of sockeye and pink salmon run size, migration timing and route, in-river migration abundance (i.e., Mission passage) and management adjustments. Thus, the Panel responds to deviations from pre-season expectations in their weekly fishing plans and most substantive fishery decisions are based on in-season rather than pre-season assessments. The Fraser River Panel Technical Committee (Appendix I) works in conjunction with Staff to facilitate Panel activities by providing their respective National sections with technical advice and ensuring timely exchange of data between Staff and the Parties.

# III. PANEL MANAGEMENT ACTIVITIES

In 2009, the pre-season fishing plan focused on the harvest of Summer-run Fraser sockeye while providing protection for Early Summer and Late-run stocks. For Fraser River pink salmon, the primary challenge was to provide harvest opportunities within the constraints required to protect Late-run sockeye stocks. The need to protect Late-run sockeye was expected to constrain the harvests of sockeye and pink salmon. The sockeye forecast (10,488,000 fish, Table 1) was below the long-term (1980-2005) cycle average (12,000,000 fish), while the pink salmon forecast (17,535,000 fish) was above the 1977-2007 average (15,000,000 fish). The likely continuation of early upstream migration behaviour of Late-run sockeye and associated en route migration loss was addressed in the document, "Guidelines for Fishing Plans to Address Late-run Concerns", that was developed by the Panel (Appendix D). For Canadian fisheries, additional constraints to protect Cultus Lake sockeye were expected. Based on the timing and abundance forecasts and escapement plans that were adopted for 2009, the pre-season planning process indicated that significant harvest of Summer-run sockeye and pink salmon were potentially available.

## A. Pre-season Planning

Pre-season management plans for Panel Area fisheries were developed by the Panel using the Fishery Simulation Model[3]. This model helps the Panel to evaluate the impacts of various fishery options on the achievement of management objectives. Model inputs include forecasts of abundance, migration timing, diversion rate and management adjustments (MAs), plus objectives for spawning escapement and catch allocation described below. As in other years with significant Late-run conservation concerns, simulation modeling focused on the harvest of Summer-run sockeye while protecting weaker co-migrating Early Summer and Late-run stocks.

Canada provided run-size forecasts for Fraser sockeye and pink salmon that corresponded to the 10%, 25%, 50%, 75% and 90% levels of probability that actual returns would exceed the forecast abundances (Appendix B, Table 1). The estimates associated with these various probability levels represent the range of possible returns given variability in the historical data and average spawner-to-adult rates of return. To illustrate what this means, there was a 3 out of 4 chance that actual returns would exceed the 75p forecasts (6,039,000 sockeye and 12,490,000 pink salmon), while at the 50p level or median forecast there was an equal chance that actual returns would be either above or below the forecast. For Fraser pink salmon and most sockeye management groups the Panel adopted the 50p forecast for planning purposes. However, to compensate for a tendency for Early Stuart forecasts to be too high in recent years the Panel

[3] Cave, J.D. and W.J. Gazey. 1994. A pre-season simulation model for fisheries on Fraser River sockeye salmon (O. nerka). Can. J. Fish. Aquat. Sci. 51(7): 1535-1549.

adopted the lower 75p forecast (165,000 fish) in 2009. The resulting forecasts of total return were 10,488,000 Fraser sockeye and 17,535,000 Fraser River pink salmon.

At these abundance levels, spawning escapement targets totalled 4,514,000 Fraser sockeye and 6,000,000 Fraser pink salmon (Table 1). The escapement targets were calculated using Total Allowable Mortality (i.e., TAM) rules from Canada's spawning escapement plan (Appendix B, Table 2), with one exception. Namely, the Panel agreed that the target for Late-run sockeye was based on a maximum exploitation rate of 20%.

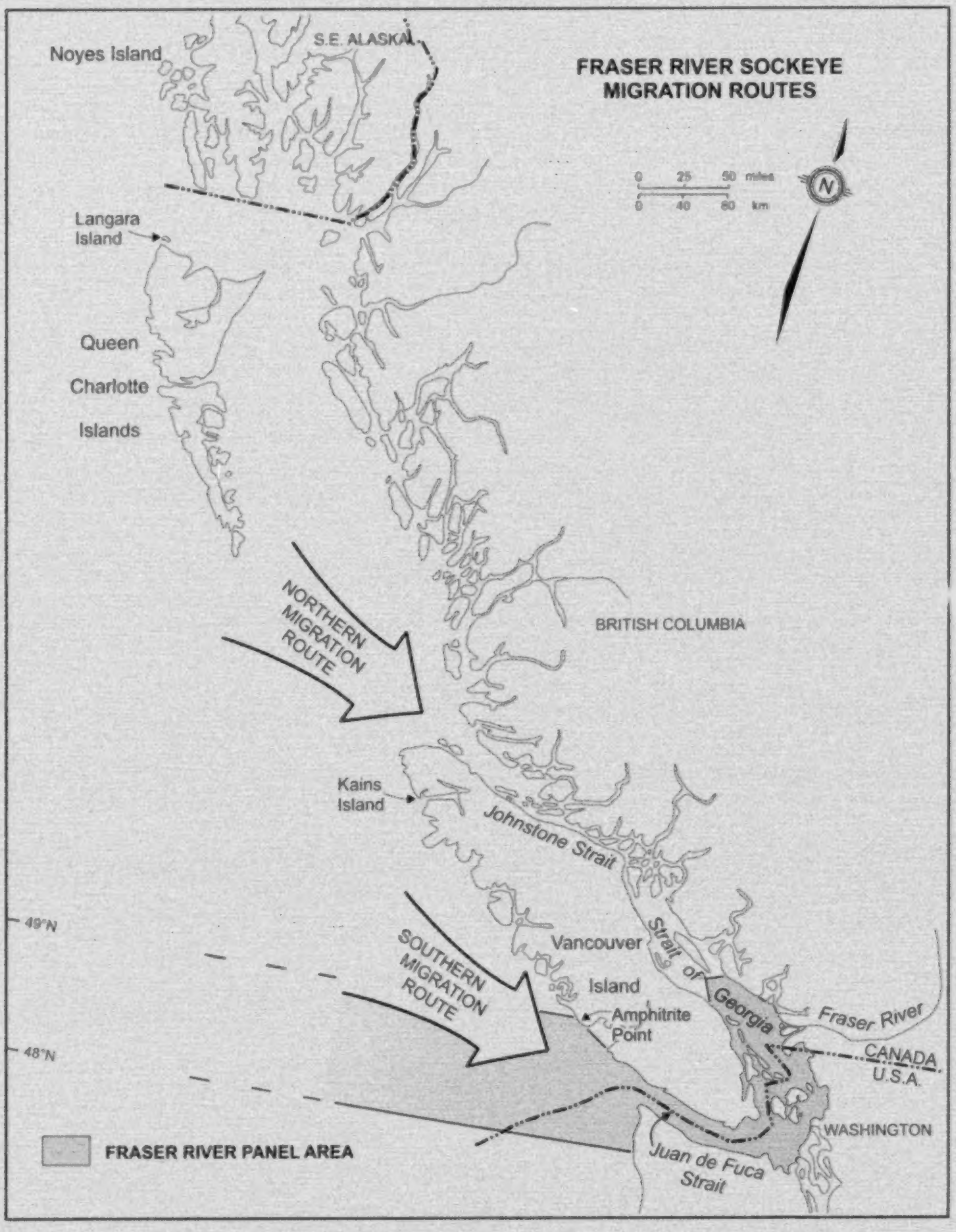


**Figure 2.** The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migrating to the Fraser River.

Management Adjustments were added to the escapement targets for Early Stuart and Early Summer sockeye to compensate for expected differences (DBEs) between in-season and spawning ground estimates of escapement. These MAs were based on regression models that relate historic

DBE levels to environmental conditions (discharge and temperature) in the Fraser River near Hells Gate, with snowpack and weather-derived pre-season forecasts of such river conditions provided by DFO. Due to generally lower than average snowfall accumulations in the Fraser watershed (from BC's River Forecast Centre) and projections of warmer than average air temperatures (from Environment Canada), discharge levels were projected to be lower than average during the early to mid-summer time period and river temperatures were projected to be warmer than average. Based on these data, the Panel adopted predicted MA factors (i.e., pMA) of 0.46 for Early Stuart, 0.40 for Early Summer and zero for Summer-run sockeye as pre-season estimates. The numerical MAs calculated from the spawning escapement targets and MA factors are shown in Table 1.

Pre-season expectations of migration parameters included a 28% (later revised to 32%) diversion rate of Fraser River sockeye through Johnstone Strait (Figure 2, forecast provided by DFO), and a 40% diversion rate for Fraser pink salmon (the historical average, revised to 47% in-season). Expected Area 20 50% migration dates were July 2 (later revised to July 4) for Early Stuart, July 26 for Early Summer, August 5 for Summer, August 11 for Birkenhead and Late-run sockeye, and August 25 for pink salmon. These dates were based on historical averages and DFO forecasts of Early Stuart and Chilko timing. Area 20 dates are indices of marine migration timing and represent the date when 50% (half) of the total run would have entered Juan de Fuca Strait (Canadian Area 20) if the entire run had migrated via that route. Projected daily abundances generated from these dates are shown in Figures 3 and 4. To model Late-run harvest impacts, the 50% upstream migration date past Mission was assumed to occur during the third week of August (August 23).

The Total Allowable Catch (TAC) and international harvest shares in 2009 were to be calculated according to Annex IV, Chapter 4 of the Pacific Salmon Treaty[1] and the February 15, 2008[2] "Commission Guidance to the Fraser River Panel". Pre-season projections of TAC based on the assumptions described above were 5,394,000 Fraser sockeye and 11,525,000 Fraser pinks (Table 1). The specified U.S. (Washington) shares were 16.5% of the Fraser sockeye TAC and 25.7% of the Fraser pink salmon TAC.

In terms of domestic goals, Treaty Indian fishers were allocated 67.7% and All Citizen fishers the remainder of the U.S. share of Fraser sockeye. The U.S. share of Fraser pinks was to be shared equally between Treaty Indian and All Citizen fishers.

In Canada, pre-season catch expectations for sockeye included 260,000 fish for marine First Nations, 749,000 fish for in-river First Nations, 30,000 fish for marine recreational fishers and 140,000 fish for in-river recreational fishers. The remaining Canadian sockeye share was to be divided within the commercial sector as follows: 47.5% for Area B purse seines, 21.5% for Area D gillnets, 25.0% for Area E gillnets and 6% for Area H trollers. Commercial allocations of pink salmon were 70% for Area B purse seines, 4% for Area D gillnets, 6.5% for Area E gillnets, 6.5% for Area G trollers and 13% for Area H trollers.

During the pre-season planning process, the Parties identified stocks for which they had conservation and management concerns. Species and stocks identified by Canada included Cultus, Sakinaw and Nimpkish sockeye, Thompson coho and steelhead, Chilcotin steelhead, early-timed Fraser chinook and Vancouver Island chinook. Species and stocks identified by the U.S. included South Fork Nooksack and South Fork Stillaguamish chinook, and Hood Canal summer chum.

The Panel adopted a management plan in June, which included the "Management Plan Principles and Constraints", "Guidelines to Address Late Run Concerns", and "2009 Regulations" (Appendices C, D and E). In the pre-season plan, low impact fisheries in both U.S. and Canadian Panel waters were expected to start the week of July 19-25. If in-season assessments indicated that the abundance or timing of returning Early Summer or Summer-run stocks were significantly different than forecast, then the commencement and duration of fisheries could be affected.

**Table 1.** Pre-season and in-season updates of run size, spawning escapement targets and other TAC-related values for Fraser River sockeye and pink salmon in 2009. The available harvest (run size minus spawning escapement target and management adjustment), catch to date, Mission escapement to date and migration timing are also shown.

| | | | | TAC | | | | | Available | | | 50% Migration Date | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Management Group | Total Abundance | Spawning Escapement Target | pMA | Manage-ment Adjust. | Test Fishing | Aboriginal Fishery Exemption | Total Allowable Catch | Harvest (incld. TF + AFE) | Catch to date | Mission Passage to date | Area 20 | Mission |
| June 17 Pre-season | Early Stuart | 165,000 | 156,000 | 0.46 | 71,800 | 2,400 | 10,000 | 0 | 0 | 0 | 0 | 2-Jul | |
| | Early Summer | 739,000 | 295,600 | 0.3995 | 118,100 | 8,000 | 30,600 | 286,700 | 325,300 | 0 | 0 | 26-Jul | |
| | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 0 | 0 | 5-Aug | |
| | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 0 | 0 | 11-Aug | |
| | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 0 | 0 | 11-Aug | 23-Aug |
| | **Sockeye** | **10,488,000** | **4,514,400** | | **189,900** | **64,700** | **400,000** | **5,394,200** | **5,846,500** | **0** | **0** | | |
| | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **0** | **0** | **25-Aug** | |
| July 2 In-season | Early Stuart | 165,000 | 156,000 | 0.46 | 71,800 | 2,400 | 10,000 | 0 | 0 | 773 | 21,840 | 4-Jul | |
| | Early Summer | 739,000 | 295,600 | 0.3995 | 118,100 | 8,000 | 30,600 | 286,700 | 325,300 | 111 | 5,460 | 26-Jul | |
| | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 0 | 0 | 5-Aug | |
| | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 0 | 0 | 11-Aug | |
| | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 0 | 0 | 11-Aug | |
| | **Sockeye** | **10,488,000** | **4,514,400** | | **189,900** | **64,700** | **400,000** | **5,394,200** | **5,846,500** | **884** | **27,300** | | |
| | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | **0** | **11,525,000** | **11,535,000** | **0** | | 25-Aug | |
| July 7 In-season | Early Stuart | 165,000 | 156,000 | 0.46 | 71,800 | 2,400 | 10,000 | 0 | 0 | 1,418 | 77,735 | 4-Jul | |
| | Early Summer | 739,000 | 295,600 | 0.3995 | 118,100 | 8,000 | 30,600 | 286,700 | 325,300 | 527 | 14,981 | 26-Jul | |
| | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 0 | 0 | 5-Aug | |
| | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 0 | 0 | 11-Aug | |
| | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 0 | 0 | 11-Aug | |
| | **Sockeye** | **10,488,000** | **4,514,400** | | **189,900** | **64,700** | **400,000** | **5,394,200** | **5,846,500** | **1,945** | **92,716** | | |
| | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | **0** | **11,525,000** | **11,535,000** | **0** | | 25-Aug | |
| July 10 In-season | Early Stuart | 140,000 | 140,000 | 0.33 | 46,200 | 2,400 | 10,000 | 0 | 0 | 1,628 | 90,853 | 29-Jun | |
| | Early Summer | 739,000 | 295,600 | 0.3995 | 118,100 | 8,000 | 30,600 | 286,700 | 325,300 | 591 | 20,701 | 26-Jul | |
| | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 76 | 0 | 5-Aug | |
| | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 0 | 0 | 11-Aug | |
| | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 9 | 0 | 11-Aug | |
| | **Sockeye** | **10,463,000** | **4,498,400** | | **164,300** | **64,700** | **400,000** | **5,394,200** | **5,846,500** | **2,304** | **111,554** | | |
| | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | **0** | **11,525,000** | **11,535,000** | **0** | | 25-Aug | |
| July 14 In-season | Early Stuart | 140,000 | 140,000 | 0.33 | 46,200 | 2,400 | 10,000 | 0 | 0 | 1,719 | 99,428 | 29-Jun | |
| | Early Summer | 739,000 | 295,600 | 0.3995 | 118,100 | 8,000 | 30,600 | 286,700 | 325,300 | 742 | 24,110 | 26-Jul | |
| | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 107 | 1,969 | 5-Aug | |
| | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 0 | 0 | 11-Aug | |
| | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 55 | 742 | 11-Aug | |
| | **Sockeye** | **10,463,000** | **4,498,400** | | **164,300** | **64,700** | **400,000** | **5,394,200** | **5,846,500** | **2,623** | **126,249** | | |
| | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | **0** | **11,525,000** | **11,535,000** | **0** | | 25-Aug | |
| July 17 In-season | Early Stuart | 110,000 | 110,000 | 0.49 | 53,900 | 2,400 | 10,000 | 0 | 0 | 2,063 | 100,000 | 28-Jun | |
| | Early Summer | 739,000 | 295,600 | 0.3995 | 118,100 | 8,000 | 30,600 | 286,700 | 325,300 | 991 | 27,580 | 26-Jul | |
| | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 196 | 40 | 5-Aug | |
| | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 0 | 0 | 11-Aug | |
| | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 161 | 1,830 | 11-Aug | |
| | **Sockeye** | **10,433,000** | **4,468,400** | | **172,000** | **64,700** | **400,000** | **5,394,200** | **5,846,500** | **3,411** | **129,450** | | |
| | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | **0** | **11,525,000** | **11,535,000** | **100** | | 25-Aug | |
| July 21 In-season | Early Stuart | 110,000 | 110,000 | 0.49 | 53,900 | 2,400 | 10,000 | 0 | 0 | 5,032 | 101,730 | 28-Jun | |
| | Early Summer | 739,000 | 295,600 | 0.3995 | 118,100 | 8,000 | 30,600 | 286,700 | 325,300 | 4,001 | 29,890 | 26-Jul | |
| | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 1,351 | 1,260 | 5-Aug | |
| | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 38 | 30 | 11-Aug | |
| | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 591 | 2,580 | 11-Aug | |
| | **Sockeye** | **10,433,000** | **4,468,400** | | **172,000** | **64,700** | **400,000** | **5,394,200** | **5,846,500** | **11,013** | **135,490** | | |
| | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | **0** | **11,525,000** | **11,535,000** | **400** | | 25-Aug | |
| July 23 In-season | Early Stuart | 110,000 | 110,000 | 0.49 | 53,900 | 2,400 | 10,000 | 0 | 0 | 4,707 | 79,890 | 28-Jun | |
| | Early Summer | 739,000 | 295,600 | 0.3995 | 118,100 | 8,000 | 30,600 | 286,700 | 325,300 | 4,294 | 29,890 | 26-Jul | |
| | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 2,267 | 3,230 | 5-Aug | |
| | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 36 | 30 | 11-Aug | |
| | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 756 | 3,900 | 11-Aug | |
| | **Sockeye** | **10,433,000** | **4,468,400** | | **172,000** | **64,700** | **400,000** | **5,394,200** | **5,846,500** | **12,060** | **116,940** | | |
| | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **500** | | 25-Aug | |

**Table 1**, continued on next page

**Table 1**, continued.

| Date | | Management Group | Total Abundance | TAC: Spawning Escapement Target | TAC: pMA | TAC: Management Adjust. | TAC: Test Fishing | TAC: Aboriginal Fishery Exemption | TAC: Total Allowable Catch | Available Harvest (incld. TF + AFE) | Catch to date | Mission Passage to date | 50% Migration Date: Area 20 | 50% Migration Date: Mission |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| July 24 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 2,400 | 10,000 | 0 | 0 | 4,726 | 81,420 | 29-Jun | |
| | | Early Summer | 264,000 | 179,000 | 0.3745 | 67,000 | 8,000 | 30,600 | 0 | 18,000 | 4,441 | 33,060 | 26-Jul | |
| | | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 2,702 | 4,900 | 5-Aug | |
| | | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 36 | 30 | 11-Aug | |
| | | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 825 | 4,370 | 11-Aug | |
| | | **Sockeye** | **9,933,000** | **4,326,800** | | **99,300** | **64,700** | **400,000** | **5,107,500** | **5,539,200** | **12,730** | **123,780** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **500** | | 25-Aug | |
| July 28 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 2,400 | 10,000 | 0 | 0 | 5,390 | 81,270 | 29-Jun | |
| | | Early Summer | 150,000 | 150,000 | 0.3745 | 56,200 | 8,000 | 30,600 | 0 | 0 | 6,090 | 45,240 | 26-Jul | |
| | | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 6,033 | 28,030 | 5-Aug | |
| | | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 125 | 30 | 11-Aug | |
| | | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 1,579 | 13,890 | 11-Aug | |
| | | **Sockeye** | **9,819,000** | **4,297,800** | | **88,500** | **64,700** | **400,000** | **5,107,500** | **5,521,200** | **19,217** | **168,460** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **600** | | 25-Aug | |
| July 31 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 2,400 | 10,000 | 0 | 0 | 7,991 | 81,270 | 29-Jun | |
| | | Early Summer | 150,000 | 150,000 | 0.5123 | 76,800 | 8,000 | 30,600 | 0 | 0 | 9,354 | 61,150 | 26-Jul | |
| | | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 14,809 | 51,310 | 5-Aug | |
| | | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 295 | 30 | 11-Aug | |
| | | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 3,087 | 27,630 | 11-Aug | |
| | | **Sockeye** | **9,819,000** | **4,297,800** | | **109,100** | **64,700** | **400,000** | **5,107,500** | **5,521,200** | **35,536** | **221,390** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **800** | | 25-Aug | |
| August 4 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 2,400 | 10,000 | 0 | 0 | 7,991 | 81,270 | 29-Jun | |
| | | Early Summer | 150,000 | 150,000 | 0.5123 | 76,800 | 8,000 | 30,600 | 0 | 0 | 9,484 | 70,970 | 26-Jul | |
| | | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 50,400 | 342,600 | 4,813,200 | 5,206,200 | 13,409 | 91,010 | 5-Aug | |
| | | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 385 | 1,960 | 11-Aug | |
| | | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 3,127 | 34,090 | 11-Aug | |
| | | **Sockeye** | **9,819,000** | **4,297,800** | | **109,100** | **64,700** | **400,000** | **5,107,500** | **5,521,200** | **34,396** | **279,300** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **2,090** | | 25-Aug | |
| August 7 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 10,000 | 0 | 0 | 8,097 | 81,280 | 29-Jun | |
| | | Early Summer | 150,000 | 150,000 | 0.5123 | 76,800 | 5,000 | 30,600 | 0 | 0 | 9,740 | 94,920 | 26-Jul | |
| | | Summer | 8,677,000 | 3,470,800 | 0.00 | 0 | 25,000 | 342,600 | 4,838,600 | 5,206,200 | 14,919 | 172,690 | 5-Aug | |
| | | Birkenhead | 334,000 | 133,600 | | | 1,500 | 5,800 | 193,100 | 200,400 | 499 | 6,270 | 11-Aug | |
| | | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 3,658 | 42,710 | 11-Aug | |
| | | **Sockeye** | **9,819,000** | **4,297,800** | | **109,100** | **35,640** | **400,000** | **5,132,900** | **5,521,200** | **36,913** | **397,870** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **700** | | 25-Aug | |
| August 11 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 10,000 | 0 | 0 | 8,107 | 82,620 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 30,600 | 0 | 0 | 10,530 | 120,470 | 30-Jul | |
| | | Summer | 600,000 | 520,000 | 0.32 | 166,400 | 25,000 | 342,600 | 0 | 0 | 18,229 | 315,870 | 4-Aug | |
| | | Birkenhead | 334,000 | 289,500 | | | 1,500 | 5,800 | 37,200 | 44,500 | 779 | 11,550 | 11-Aug | |
| | | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 5,028 | 78,500 | 11-Aug | |
| | | **Sockeye** | **1,767,000** | **1,527,900** | | **303,700** | **35,640** | **400,000** | **138,400** | **159,100** | **42,673** | **609,010** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **1,610** | | 25-Aug | |
| August 14 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 10,000 | 0 | 0 | 8,276 | 82,440 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 30,600 | 0 | 0 | 11,269 | 126,770 | 30-Jul | |
| | | Summer | 600,000 | 520,000 | 0.32 | 166,400 | 25,000 | 342,600 | 0 | 0 | 21,377 | 344,080 | 4-Aug | |
| | | Birkenhead | 334,000 | 289,500 | | | 1,500 | 5,800 | 37,200 | 44,500 | 978 | 12,080 | 11-Aug | |
| | | Late | 573,000 | 458,400 | | na | 2,400 | 11,000 | 101,200 | 114,600 | 5,598 | 118,450 | 11-Aug | |
| | | **Sockeye** | **1,767,000** | **1,527,900** | | **303,700** | **35,640** | **400,000** | **138,400** | **159,100** | **47,498** | **683,820** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **3,710** | | 25-Aug | |
| August 18 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,276 | 82,440 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 11,389 | 130,710 | 30-Jul | |
| | | Summer | 700,000 | 520,000 | 0.32 | 166,400 | 25,000 | 25,000 | 0 | 13,600 | 22,117 | 441,850 | 6-Aug | |
| | | Birkenhead | 100,000 | 74,300 | | | 1,500 | 24,200 | 0 | 25,700 | 1,118 | 20,060 | 18-Aug | |
| | | Late | 450,000 | 360,000 | | na | 2,400 | 84,000 | 3,600 | 90,000 | 6,258 | 144,010 | 12-Aug | |
| | | **Sockeye** | **1,510,000** | **1,214,300** | | **303,700** | **35,640** | **152,200** | **3,600** | **129,300** | **49,158** | **819,070** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **3,840** | | 25-Aug | |

**Table 1**, continued on next page

**Table 1**, continued.

| Date | | Management Group | Total Abundance | TAC: Spawning Escapement Target | TAC: pMA | TAC: Management Adjust. | TAC: Test Fishing | TAC: Aboriginal Fishery Exemption | TAC: Total Allowable Catch | Available Harvest (incld. TF + AFE) | Catch to date | Mission Passage to date | 50% Migration Date: Area 20 | 50% Migration Date: Mission |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| August 21 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,401 | 82,450 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 13,139 | 144,140 | 30-Jul | |
| | | Summer | 700,000 | 520,000 | 0.21 | 109,200 | 18,000 | 25,000 | 27,800 | 70,800 | 30,827 | 480,560 | 6-Aug | |
| | | Birkenhead | 100,000 | 74,300 | | | 1,500 | 24,200 | 0 | 25,700 | 1,410 | 30,290 | 18-Aug | |
| | | Late | 450,000 | 360,000 | | na | 6,000 | 84,000 | 0 | 90,000 | 7,396 | 177,690 | 12-Aug | |
| | | **Sockeye** | **1,510,000** | **1,214,300** | | **246,500** | **32,240** | **152,200** | **27,800** | **186,500** | **61,173** | **915,130** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **8,400** | | 25-Aug | |
| August 25 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,652 | 82,450 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 13,989 | 154,090 | 30-Jul | |
| | | Summer | 650,000 | 520,000 | 0.28 | 145,600 | 18,000 | 25,000 | 0 | 0 | 32,445 | 538,450 | 4-Aug | |
| | | Birkenhead | 60,000 | 48,000 | | | 1,500 | 10,500 | 0 | 12,000 | 1,563 | 36,470 | 12-Aug | |
| | | Late | 450,000 | 360,000 | | na | 6,000 | 84,000 | 0 | 90,000 | 8,282 | 181,010 | 12-Aug | |
| | | **Sockeye** | **1,420,000** | **1,188,000** | | **282,900** | **32,240** | **138,500** | **0** | **102,000** | **64,931** | **992,470** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **8,890** | | 28-Aug | |
| August 26 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,592 | 82,450 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 15,376 | 156,170 | 30-Jul | |
| | | Summer | 650,000 | 520,000 | 0.28 | 145,600 | 18,000 | 25,000 | 0 | 0 | 42,443 | 548,660 | 4-Aug | |
| | | Birkenhead | 60,000 | 48,000 | | | 1,500 | 10,500 | 0 | 12,000 | 2,173 | 38,010 | 12-Aug | |
| | | Late | 450,000 | 360,000 | | na | 6,000 | 84,000 | 0 | 90,000 | 10,131 | 188,190 | 12-Aug | |
| | | **Sockeye** | **1,420,000** | **1,188,000** | | **282,900** | **32,240** | **138,500** | **0** | **102,000** | **78,715** | **1,013,480** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **24,910** | | 28-Aug | |
| August 28 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,592 | 82,450 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 15,376 | 154,850 | 30-Jul | |
| | | Summer | 650,000 | 520,000 | 0.28 | 145,600 | 18,000 | 35,000 | 0 | 0 | 42,533 | 555,990 | 4-Aug | |
| | | Birkenhead | 60,000 | 48,000 | | | 1,500 | 10,500 | 0 | 12,000 | 2,223 | 40,380 | 12-Aug | |
| | | Late | 400,000 | 320,000 | | na | 6,000 | 74,000 | 0 | 80,000 | 10,221 | 194,570 | 10-Aug | |
| | | **Sockeye** | **1,370,000** | **1,148,000** | | **282,900** | **32,240** | **138,500** | **0** | **92,000** | **78,945** | **1,028,240** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **24,910** | | 28-Aug | |
| September 1 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,592 | 82,450 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 15,686 | 163,540 | 30-Jul | |
| | | Summer | 650,000 | 520,000 | 0.28 | 145,600 | 18,000 | 35,000 | 0 | 0 | 44,113 | 591,540 | 4-Aug | |
| | | Birkenhead | 60,000 | 48,000 | | | 1,500 | 10,500 | 0 | 12,000 | 2,593 | 49,800 | 12-Aug | |
| | | Late | 400,000 | 320,000 | | na | 6,000 | 74,000 | 0 | 80,000 | 11,501 | 207,290 | 10-Aug | |
| | | **Sockeye** | **1,370,000** | **1,148,000** | | **282,900** | **32,240** | **138,500** | **0** | **92,000** | **82,485** | **1,094,620** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **563,280** | | 28-Aug | |
| September 4 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,592 | 82,450 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 16,991 | 168,440 | 30-Jul | |
| | | Summer | 650,000 | 520,000 | 0.28 | 145,600 | 18,000 | 35,000 | 0 | 0 | 51,767 | 608,170 | 4-Aug | |
| | | Birkenhead | 60,000 | 48,000 | | | 1,500 | 10,500 | 0 | 12,000 | 3,404 | 58,850 | 12-Aug | |
| | | Late | 400,000 | 320,000 | | na | 6,000 | 74,000 | 0 | 80,000 | 14,088 | 213,500 | 10-Aug | |
| | | **Sockeye** | **1,370,000** | **1,148,000** | | **282,900** | **32,240** | **138,500** | **0** | **92,000** | **94,842** | **1,131,410** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **1,107,520** | | 28-Aug | |
| September 8 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,592 | 82,450 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 17,091 | 170,510 | 30-Jul | |
| | | Summer | 650,000 | 520,000 | 0.28 | 145,600 | 18,000 | 35,000 | 0 | 0 | 52,447 | 628,570 | 4-Aug | |
| | | Birkenhead | 60,000 | 48,000 | | | 1,500 | 10,500 | 0 | 12,000 | 3,634 | 61,910 | 12-Aug | |
| | | Late | 400,000 | 320,000 | | na | 6,000 | 74,000 | 0 | 80,000 | 14,398 | 232,720 | 10-Aug | |
| | | **Sockeye** | **1,370,000** | **1,148,000** | | **282,900** | **32,240** | **138,500** | **0** | **92,000** | **96,162** | **1,176,160** | | |
| | | **Pink** | **17,535,000** | **6,000,000** | | | **10,000** | | **11,525,000** | **11,535,000** | **1,949,640** | | 28-Aug | |
| September 11 | In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,596 | 82,460 | 29-Jun | |
| | | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 17,854 | 184,160 | 30-Jul | |
| | | Summer | 650,000 | 520,000 | 0.28 | 145,600 | 18,000 | 35,000 | 0 | 0 | 56,979 | 612,710 | 4-Aug | |
| | | Birkenhead | 60,000 | 48,000 | | | 1,500 | 10,500 | 0 | 12,000 | 3,876 | 62,050 | 12-Aug | |
| | | Late | 400,000 | 320,000 | | na | 6,000 | 74,000 | 0 | 80,000 | 15,415 | 343,040 | 10-Aug | |
| | | **Sockeye** | **1,370,000** | **1,148,000** | | **282,900** | **32,240** | **138,500** | **0** | **92,000** | **102,720** | **1,284,420** | | |
| | | **Pink** | **19,500,000** | **6,000,000** | | | **10,000** | | **13,490,000** | **13,500,000** | **2,873,130** | | 29-Aug | |

**Table 1**, continued on next page

**Table 1**, continued.

| Date | Management Group | Total Abundance | TAC: Spawning Escapement Target | TAC: pMA | TAC: Management Adjust. | TAC: Test Fishing | TAC: Aboriginal Fishery Exemption | TAC: Total Allowable Catch | Available Harvest (incld. TF + AFE) | Catch to date | Mission Passage to date | 50% Migration Date: Area 20 | 50% Migration Date: Mission |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| September 23 In-season | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,597 | 82,460 | 29-Jun | |
| | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 18,545 | 185,990 | 30-Jul | |
| | Summer | 650,000 | 520,000 | 0.28 | 145,600 | 18,000 | 35,000 | 0 | 0 | 58,445 | 615,740 | 4-Aug | |
| | Birkenhead | 60,000 | 48,000 | | | 1,500 | 10,500 | 0 | 12,000 | 3,946 | 66,340 | 12-Aug | |
| | Late | 400,000 | 320,000 | | na | 6,000 | 74,000 | 0 | 80,000 | 15,995 | 348,920 | 10-Aug | |
| | **Sockeye** | **1,370,000** | **1,148,000** | | **282,900** | **32,240** | **138,500** | **0** | **92,000** | **105,528** | **1,299,450** | | |
| | **Pink** | **19,500,000** | **6,000,000** | | | **10,000** | | **13,490,000** | **13,500,000** | **3,590,783** | | 29-Aug | |
| October 3 TAC Date * | Early Stuart | 85,000 | 85,000 | 0.38 | 32,300 | 1,740 | 7,000 | 0 | 0 | 8,597 | 82,460 | 29-Jun | 5-Jul |
| | Early Summer | 175,000 | 175,000 | 0.6000 | 105,000 | 5,000 | 12,000 | 0 | 0 | 18,545 | 186,420 | 30-Jul | 7-Aug |
| | Summer | 650,000 | 520,000 | 0.28 | 145,600 | 18,000 | 35,000 | 0 | 0 | 58,445 | 616,280 | 4-Aug | 11-Aug |
| | Birkenhead | 60,000 | 48,000 | | | 1,500 | 10,500 | 0 | 12,000 | 3,946 | 67,050 | 12-Aug | 22-Aug |
| | Late | 400,000 | 320,000 | | na | 6,000 | 74,000 | 0 | 80,000 | 15,995 | 351,240 | 10-Aug | 23-Aug |
| | **Sockeye** | **1,370,000** | **1,148,000** | | **282,900** | **32,240** | **138,500** | **0** | **92,000** | **105,528** | **1,303,450** | | **12-Aug** |
| | **Pink** | **19,500,000** | **6,000,000** | | | **10,000** | | **13,490,000** | **13,500,000** | **3,590,783** | | **29-Aug** | **9-Sep** |

* The TAC is determined by the run sizes and TAC deductions (spawning escapement targets, management adjustments, projected test fishing catches and AF Exemptions) that were in effect when Panel control of the last U.S. fishery area was relinquished.

## B. In-season Management

The Fraser River Panel convened 28 times between July 2 and September 23, to discuss run status and enact in-season fisheries regulations (Appendix F) directed at the harvest of Fraser River sockeye and pink salmon in Panel Areas.

The main events of the season are summarized below. Much of the corresponding data are shown in Table 1.

**June 28 – July 4:** The first in-season Panel meeting took place on July 2. Preliminary assessments indicated the abundance of Early Stuart sockeye was tracking below forecast. Migration conditions for sockeye in the Fraser River were near average.

**July 5 – 11:** In the Area 20 gillnet test fishery, small sockeye catches and low age $4_2$ proportions (58% compared to pre-season forecast of 90%) indicated weakness in the return of this cohort. DNA analyses of samples from Area 20 indicated a prevalence of Early Stuart (about 60%) compared to Early Summer sockeye (about 30%). A low proportion of Harrison sockeye, which often exhibit a broad marine migration, were also present. Catches in the Whonnock and Cottonwood gillnet test fisheries continued to be low, which made it difficult to estimate the species composition of salmon migrating past the Mission hydroacoustic site. Fraser River discharge levels as measured near Hope were below average for the date, while river temperatures were slightly above average. The Panel adopted a lower Early Stuart run size of 140,000 sockeye, a 50% Area 20 date of June 29 (five days earlier than forecast), and a reduced pMA factor of 0.33.

**July 12 – 18:** Test fishery catches of sockeye in marine (U.S. Area 5, and Canadian Areas 12 and 20) and in-river gillnet test fisheries continued to be low, especially in the river where seals were removing sockeye from the nets. The low catches in river test fisheries reduced sample sizes available for stock discrimination. Proportions of age 4 sockeye also remained far below expectations. Area 20 samples consisted of 14% Early Stuart, 42% Early Summer, 20% Summer and 24% Late-run (Harrison) sockeye, indicating a transition to Early Summer and Summer-run stocks. The Panel adopted a reduced Early Stuart run size of 110,000 fish with marine (Area 20) timing of June 28. Assessments of Early Summer sockeye indicated they were 4-5 days later than expected if they were returning at their forecast abundance. Water temperatures were forecast to increase to 19.1°C, causing the Panel to adopt a larger Early Stuart MA factor of 0.49.

**July 19 – 25:** Although daily catches of Fraser sockeye in the Areas 20 and 12 gillnet test fisheries increased, they remained lower than expected. The proportion of Summer-run stocks increased in marine areas, but the lack of a corresponding increase in abundance signalled that abundances of Early Summer and Summer stocks were less than forecast rather than late in arriving. Similarly, the lower than expected proportions of age 4 sockeye and higher proportions of age 5 sockeye continued to indicate lower abundances than forecast. Sockeye observations in the U.S. Area 7 reefnet test fishery were reasonably strong, although this apparent strength may have been partly due to favourable tides for viewing sockeye. Debris in the Fraser River was thought to be causing a positive bias in hydroacoustically-derived estimates of salmon passage at Mission. Staff advised the Panel that a re-analysis of the hydroacoustic data would result in a significant reduction in the estimated abundance of Early Stuart sockeye, and to a lesser extent of Early Summer and Summer-run sockeye. By the end of the week the abundance of sockeye accounted through marine areas was only about one-quarter of expectations for Early Summer and one-sixth of expectations for Summer-run sockeye. Due to the low returns observed to date and the re-analysis of Mission hydroacoustic data, the Panel adopted reduced run-size estimates of 85,000 fish for Early Stuart (Area 20 50% date of June 29) and 264,000 fish for Early Summer sockeye (90% probability level forecast). The slightly later timing of the Early Stuart run resulted in a lower estimated MA factor of 0.38, which the Panel adopted. None of the commercial fisheries that were expected in the pre-season plan to begin this week were opened.

**July 26 – August 1:** Estimates of daily sockeye migration increased slightly in marine areas and the lower river. Samples from the Area 20 purse seine and gillnet test fisheries indicated a stock composition of 24% Early Summer, 45% Summer, 3% Birkenhead and 28% Late-run (primarily Harrison) sockeye, and an age composition that included only 41% age 4 Fraser sockeye. The relatively low proportions of Summer-run sockeye in the samples and relatively high proportions of several small stocks that should have been "flooded out" by these Summer-run stocks reinforced the indications of low overall sockeye abundance. Early Summer and Summer-run sockeye would respectively have had to be 13 and 9 days later than forecast in order to reach their 50p forecast abundances. However, the identification of non-Harrison Late-run stocks (e.g., Weaver) in the samples suggested that Summer-run sockeye were not arriving later than expected. The recent sockeye diversion rate through Johnstone Strait appeared to be about 25%. Hells Gate observations of sockeye passage increased considerably on July 30, possibly due to a surge of sockeye that had temporarily stalled their migration. The Panel adopted a reduced Early Summer run size of 150,000 fish. It was too early in the Summer-run migration to generate abundance estimates with much confidence, especially with the unusually flat migration profile demonstrated to date. Preliminary estimates were in the 1,000,000 to 1,500,000 range. Harrison sockeye appeared to be the only Fraser stock that was returning at higher than forecast numbers. Fraser River discharge at Hope was lower than average for the date, while water temperatures were more than 3°C above average and were forecast to increase above 21°C. The Panel adopted an increased Early Summer MA factor of 0.51. Commercial fisheries remained closed.

**August 2 –8:** Sockeye catches in marine test fisheries declined sharply and Mission escapement estimates were lower than projected from marine catches. Observations of sockeye passing Hells Gate indicated a steady migration and that the fish were in good condition. Estimates of Summer-run abundance continued to be tentative due to uncertainty in marine timing estimates and the expansion lines used to project marine abundances (from CPUE models) into the river. Both Early Summer and Summer-run abundances were tracking well below levels needed to generate a TAC, although there were indications that the Early Summer run was larger than the currently adopted run size of 150,000 fish. Current run-size assessments for Chilko sockeye implied a marine survival rate of 0.45%, three times lower than the previous historic low of 1.2%. Pink salmon catches in Johnstone Strait test fisheries were higher than in Juan de Fuca Strait. Most pink salmon appeared to be small (average of 3.75 lb or 1.7 kg). Discharge levels in the Fraser River continued to track below historical means, while river temperatures peaked at 21.0°C on August 3, 2.5°C above average and close to the record high for the date of 21.2°C set in 1998. Commercial fisheries remained closed.

**August 9 –15:** There was a slight increase in marine test fishing catches of sockeye, primarily due to an influx of Late-run sockeye. Daily sockeye escapements past Mission had declined, however, and were 20% to 30% lower than projected abundances from marine areas. A Johnstone

Strait purse seine sample during this time period included 74% age-4 sockeye and a relatively high jack component, and a stock composition of 30% Summer and 56% Late-run stocks. There appeared to be a shift towards later-timed components in each of these groups. Late-run sockeye appeared to be entering the Fraser River with little delay in marine areas. Meanwhile, Fraser pinks comprised about 30% of pink salmon caught in marine test fisheries. This low contribution of Fraser pinks suggested their marine timing could be later than expected. Recent short-term diversion rate estimates for Fraser sockeye and pinks through Johnstone Strait were 38% and 50%, respectively. The Panel adopted the following updates: Early Summer run size of 175,000 fish with an Area 20 timing July 30 and MA factor of 0.60; Summer-run abundance of 600,000 fish (less than 10% of the forecast) with August 4 Area 20 timing and an increased MA factor of 0.32; and Harrison run size of 150,000 fish (almost double the forecast) with August 4 Area 20 timing. Commercial fisheries remained closed.

August 16 –22: Test fishery catches of sockeye in marine areas and estimates of in-river passage at Mission continued to indicate a low, flat migration, which made assessments of run size difficult. Early Summer stocks were still present in marine samples along with Summer and Late-run stocks. Comparisons of stock proportions in marine and river samples suggested that Late-run sockeye were delaying in the Strait of Georgia. Meanwhile, the migration of Fraser pink salmon appeared to be tracking between the 50p and 75p forecast levels, depending on whether their marine timing was closer to the pre-season estimate (August 25) or the revised forecast (August 28) recently provided by Canada. Fraser pinks comprised about 50% of pink catches in marine test fisheries. Compared to the previous week, higher numbers of Fraser pink salmon were being caught in marine test fisheries and lower numbers were being caught in in-river test fisheries and observed at Hells Gate. On August 21, Canada provided a 31% seasonal diversion rate forecast for Fraser pink salmon, as predicted by a regression model for which the explanatory variables were indices of coastal upwelling and sea surface salinity. To account for a potential negative bias in the diversion rate forecast (-16%, estimated by a retrospective evaluation of diversion rate forecasts), Staff used a 47% diversion rate when assessing pink salmon run size. Diversion rates in recent days appeared to be about 40% for sockeye and 50% for pink salmon.

Based on Staff assessments, the Panel adopted larger Summer (700,000 fish, August 6 Area 20 timing), lower Birkenhead (100,000 fish, August 18 Area 20 timing) and lower Late-run estimates of abundance (450,000 fish, August 12 Area 20 timing). The reduced Late-run estimate was the result of a larger Harrison component (200,000 fish, August 8) but smaller Late Shuswap/Weaver component (250,000 fish, August 19). The Panel also adopted a reduced Summer-run MA factor of 0.21. TACs for the sockeye management groups migrating through fishery areas were insufficient to support sockeye-directed commercial fisheries. The Panel approved a troll test fishery in the Strait of Georgia to gather information about Late-run sockeye delay in marine areas and to help project sockeye harvest impacts in potential pink-directed fisheries. All sockeye caught in this test fishery were to be released after they were sampled. Commercial fisheries remained closed.

August 23 –29: Sockeye abundance in Johnstone Strait remained steady but declined in Juan de Fuca Strait, while the abundance of pink salmon continued to build in marine areas and the river. Early Summer and Summer sockeye were still present in marine samples along with Late-run stocks. The number of Late-run sockeye estimated to be delaying in the Strait of Georgia ranged between 110,000-130,000 fish, which is notable because it marks the first substantial delay of Late-run sockeye on the 2009 cycle since the mid 1990s. A higher than projected proportion of Harrison sockeye were included among the delaying sockeye, while in the lower river the proportion of Weaver sockeye was increasing. The Fraser component of pink salmon in marine samples (60%) was relatively low compared to past years, but probably reflected strong returns of Puget Sound and Canada south coast pinks rather than a weak return of Fraser pinks. As is usually the case in odd years, the passage of pink salmon at Mission was difficult to assess hydroacoustically because they tend to migrate close to shore and in dense clumps of fish. The increasing abundance of pink salmon also made the Mission assessment of sockeye passage difficult. Nonetheless, the abundance of Fraser pink salmon was tracking above the 50p forecast level, and there was speculation that their small body size in 2009 may have slowed their migration and resulted in later than expected timing. Estimates of recent short-term diversion rates

were 75% for sockeye and 47% for pink salmon. Conditions in the Fraser River continued to be marked by lower than normal discharge levels and higher than average temperatures.

The U.S. and Canada had not agreed on a common metric for describing an acceptable level of sockeye by-catch in pink-directed fisheries, but each country made a proposal. Canada proposed a maximum sockeye mortality rate of 1% for its fisheries, calculated as the product of a sockeye encounter rate that would vary by date, area and gear and a release mortality rate that varied by gear. The U.S. proposed that sockeye make up less than 5% of the combined sockeye and pink catch in U.S. fisheries (i.e., sockeye encounter rate less than 5%), that all sockeye be released from All Citizen fisheries, and that sockeye caught in Treaty Indian fisheries be designated for Ceremonial and Subsistence (C&S) use, meaning that commercial sale of sockeye was not allowed. Because of the lack of Panel-agreed criteria for assessing fishery proposals, Staff were unable to provide formal assessments of proposed fisheries.

Panel decisions during the week included reduced run sizes for Summer (650,000 fish, August 4 Area 20 timing), Birkenhead sockeye (60,000 fish, August 12 Area 20 timing) and Late-run sockeye (400,000 fish (169,000 Harrison and 241,000 Late Shuswap/Weaver), August 10 Area 20 timing). An increased Summer-run MA factor of 0.28 was also adopted. Fishery decisions included pink-directed fishery openings for Treaty Indians (sockeye by-catch used for C&S) in Areas 4B, 5 and 6C, and for the All Citizen reefnet fishery in Area 7 (non-retention of sockeye). After assessing sockeye encounter rates in the first day of these fisheries, the Panel opened additional Treaty Indian fisheries in Areas 6, 7 and 7A (sockeye by-catch deemed C&S) and All Citizen fisheries in Areas 7 and 7A (non-retention of sockeye). To reduce potential encounters with delaying Late-run sockeye, the Iwersen's Dock Line[4] boundary was in effect for openings beginning on August 29 and for subsequent openings until it was rescinded on September 11. In Canada the Panel opened a pink-directed troll fishery in Area 18-4 and specified non-retention of sockeye.

**August 30 – September 5:** Data from the troll test fishery in the Strait of Georgia indicated continued delay of Late-run sockeye, creating some optimism that in-river survival rates may be higher than in recent years. The migration of pink salmon in marine areas (70% Fraser) remained strong but showed signs of tailing off. The short-term diversion rate for pink salmon had declined from 37% to 29%, while the average weight (1.6 kg or 3.5 lb) in marine samples was smaller than average. There were indications from comparisons of marine and river data that some pink salmon may be delaying in the Strait of Georgia. River temperatures remained higher than average, and on September 2-3 new record highs for the dates were established (18.8-18.9°C). Reports from recent fishery openings showed that minimal sockeye by-catch had occurred as sockeye encounter rates declined to less than 1% of the combined sockeye and pink abundance. The Panel approved fishery openings for Treaty Indians (sockeye by-catch used for C&S) in Areas 4B, 5 and 6C and Areas 6, 7 and 7A, and All Citizens in Areas 7 and 7A (non-retention of sockeye). Canada opened (until further notice) non-Panel pink-directed commercial fisheries with non-retention of sockeye for seine (Areas 12 and 13) and troll (Areas 12, 13 and 18) starting August 30.

**September 6 –12:** Sockeye catches in the Strait of Georgia troll test fishery declined to zero, while a surge in abundance past Mission consisted mostly of Late-run sockeye that had been delaying. The marine migration of pink salmon was declining. In Johnstone Strait the proportion of Fraser pinks was about 70% and in U.S. Areas 7 and 7A was 80%. A strong migration of pink salmon past Hells Gate was observed. Estimates of recent diversion rates ranged between 17-28%. Catches of Fraser pinks in both U.S. and Canadian fisheries were the highest since 1997, while in commercial fisheries the by-catch of sockeye was well below 1% of the catch. Purse seine test fisheries in Areas 12 and 20 that were scheduled to end on September 10 were extended, to assess the latter part of the pink salmon migration. The Panel approved pink-directed fisheries for Treaty Indians (sockeye by-catch deemed C&S) in Areas 4B, 5 and 6C and Areas 6, 7 and 7A, and All Citizen fishers in Areas 7 and 7A (non-retention of sockeye), but subsequently rescinded the final scheduled All Citizen opening because they were near their domestic allocation target. Later in the week the Panel adopted a larger run size of 19,500,000 Fraser pinks (August 29 Area 20

[4] The purpose of this boundary line is to protect Late-run sockeye delaying in marine areas near the mouth of the Fraser River.

timing), and approved pink-directed troll and seine openings in Canadian Areas 18 and 29. The Panel noted that by-catch concerns could cause these fisheries to terminate earlier than scheduled. The Panel also approved additional fishing time for Treaty Indians in Areas 4B, 5 and 6C and Areas 6, 7 and 7A, but removed the Iwersen's Dock Line fishing boundary because sockeye were no longer present in the area. Canada closed its non-Panel seine (Areas 12 and 13) and troll fisheries (Areas 12, 13 and 18) on September 11.

September 13 –19: The Panel approved a pink-directed seine fishery in Canadian Area 29. Panel regulatory control was relinquished as follows: U.S. Areas 4B, 5 and 6C on September 15 by in-season order; U.S. Areas 6 and 7 on September 18 by in-season order; and Canadian Area 20 on September 19 by pre-season regulation.

September 20 –26: At the end-of-season meeting on September 23, Staff presented the Panel with final in-season data and preliminary TAC calculations.[5] Panel control of Canadian Panel Areas 17 and 18 was relinquished on September 26 by pre-season regulation.

**Table 2.** Number of days when Canadian commercial fisheries were open for directed harvest of Fraser River pink salmon in 2009. Regulatory control of Canadian Panel Areas was relinquished by the Panel on September 19 for Area 20, September 26 for Areas 17 and 18, and October 10 for Area 29, in accordance with pre-season regulations (Appendix E).

| | Panel Areas | | | | Non-Panel Areas | | | |
|---|---|---|---|---|---|---|---|---|
| | 20 | | 29 | 18, 29 | 11-16 | | | |
| Date | Purse Seine | Gillnet | Gillnet | Troll | Purse Seine | Gillnet | Troll H | Troll G |
| Jun.7-Aug.22 | | | | | | | | |
| Aug.23-Aug.29 | | | | | | | | |
| Aug.30-Sep.5 | | | | 7 | | | | |
| Sep.6-Sep.12 | | | | 6 | | | | |
| Sep.13-Sep.19 | | | 7 | 6 | | | | |
| Sep.20-Sep.26 | | | | | | | | |
| Total | 0 | 0 | 7 | 19 | 0 | 0 | 0 | 0 |

**Table 3.** Number of days when major U.S. net fisheries in the Fraser River Panel Area were open for harvest of Fraser River sockeye and pink salmon in 2009. All Citizen fisheries were specified as sockeye non-retention, while sockeye could be retained in Treaty Indian fisheries for Ceremonial and Subsistence purposes. Regulatory control of U.S. Panel Areas was relinquished by in-season orders of the Panel (Appendix F) on September 15 for Areas 4b, 5 and 6c and September 18 for Areas 6 and 7. Panel control of Area 7a was relinquished on October 3, in accordance with pre-season regulations (Appendix E).

| | Treaty Indian | | All Citizen | | |
|---|---|---|---|---|---|
| | Areas | Areas | Areas 7 and 7A | | |
| Date | 4B, 5, 6C | 6, 7, 7A | Purse Seine | Gillnet | Reefnet |
| Jun.7-Aug.22 | | | | | |
| Aug.23-Aug.29 | 4 | 2 | 3 | 3 | 4 |
| Aug.30-Sep.5 | 7 | 7 | 3 | 3 | 7 |
| Sep.6-Sep.12 | 7 | 7 | 3 | 3 | 4 |
| Sep.13-Sep.19 | 2 | 1 | | | |
| Sep.20-Sep.26 | | | | | |
| Total | 20 | 17 | 9 | 9 | 15 |

[5] Note: At a January 14, 2011 meeting of the Fraser Small Group, it was clarified that according to the February 15, 2008 Commission Guidance the TAC date is the date when Panel control of the last U.S. fishery area was relinquished.

Regulatory control of remaining Panel Areas was relinquished in accordance with the pre-season regulations (Appendix E) as follows: Canadian Area 29 on October 10 and U.S. Area 7A on October 3. Commercial fishing times in Canadian and U.S. Panel Areas are summarized in Tables 2 and 3, respectively. While not under Panel control, management of Canadian non-Panel fisheries directed at Fraser River sockeye and pink salmon is based on the same in-season information and hierarchy of objectives, with priority given to First Nations harvest within Canada's allocation. Fishing effort in Canadian First Nations fisheries is not shown in Table 2.

# IV. MANAGEMENT INFORMATION

To facilitate decision making, the Panel requires information about the abundance, timing, migration route and catch levels of Fraser sockeye (by management group) and pink salmon. Pre-season, these quantities are provided by DFO in the form of forecasts and by PSC Staff through analysis of historical data. Staff update these estimates in-season through various assessment programs (Appendix G). Stock monitoring programs collect information about abundance at various points along the migration route using test fisheries, hydroacoustic facilities (Mission) and observers (Hells Gate). The locations and schedule for these Staff and DFO programs are listed in Table 4. These data are augmented with information from commercial and First Nations fisheries. Stock identification programs collect and analyze biological samples (e.g., DNA, scales) from various fisheries, which allows the total abundance of sockeye to be apportioned into component stock groups. Table 5 shows the stock resolution that was reported in 2009. These stock monitoring and stock identification data are combined to provide estimates of catch, escapement, daily abundance, migration timing and diversion rate, which are the basis for estimating total abundances, escapement targets and catch allocations for the different management groups. Staff also provide estimates of Management Adjustments (MAs), which are estimates of how many additional fish should be allowed to escape past Mission to increase the likelihood of achieving spawning escapement targets, given historical discrepancies and current year migration timing and river conditions. These data are compiled and analysed by Staff and the results provided to the Panel.

**Table 4.** Panel-approved stock monitoring operations (test fishery, hydroacoustic and observer) conducted during the 2009 fishing season.

| Area | Location | Gear | Dates | Operated by |
|---|---|---|---|---|
| **Canadian Panel Areas** | | | | |
| 20 | Juan de Fuca Str. | Gillnet | June 22 - August 13 | PSC |
| 20 | Juan de Fuca Str. | Purse Seine | July 22 - September 11 | PSC |
| 29-1 to 6 | Str. of Georgia | Troll | August 22 - September 9 | PSC |
| 29-14 | Fraser R. (Cottonwood) | Gillnet | July 6 - September 18 | PSC |
| 29-16 | Fraser R. (Whonnock) | Gillnet | June 22 - September 25 | PSC |
| 29-16 | Fraser R. (Mission) | Gillnet | August 21 September 9 | PSC |
| 29-16 | Fraser R. (Mission) | Hydroacoustic | June 21 - September 27 | PSC |
| | Fraser R. (Hells Gate) | Observer | July 1 - October 5 | PSC |
| **Canadian non-Panel Areas** | | | | |
| 12 | Queen Charlotte Str. (Round Is.) | Gillnet | July 12 - August 12 | DFO |
| 12 | Johnstone Str. (Naka Cr.) | Gillnet | July 17 - July 30 | DFO |
| 12 | Johnstone Str. (Blinkhorn) | Purse Seine | July 20 - September 13 | DFO |
| 13 | Lower Johnstone Str. | Purse Seine | July 26 - September 3 | DFO |
| **United States Panel Areas** | | | | |
| 5 | Juan de Fuca Str. | Gillnet | July 15 - July 30 | PSC |
| 7 | San Juan Islands | Reefnet | July 20 - August 25 | PSC |

**Table 5.** Individual stocks included in the Fraser River sockeye stock groups used in 2009.

| Stock Group | Component Stocks |
|---|---|
| **Early Stuart** | |
| Early Stuart | Early Stuart stocks |
| **Early Summer** | |
| Chilliwack | Chilliwack Lake, Dolly Varden Creek |
| Early Miscellaneous | Nadina, Bowron, Gates, Nahatlatch, Taseko |
| Seymour/Scotch | Scotch, Seymour, early Eagle, Cayenne, Upper Adams |
| North Thompson | Fennell, Raft, North Thompson |
| Pitt | Pitt |
| **Summer** | |
| Chilko | Chilko, south end Chilko Lake |
| Quesnel | Horsefly, McKinley, Mitchell, Roaring, Wasko, Blue Lead |
| Late Stuart/Stellako | Stellako, Tachie, Middle, Pinchi, Kuzkwa |
| **Birkenhead** | |
| Birkenhead | Birkenhead, Big Silver |
| **Late** | |
| Late Shuswap/Portage | Lower Adams, Portage, Lower Shuswap, Middle Shuswap, Shuswap Lake, late Eagle |
| Weaver/Cultus | Weaver, Cultus |
| Harrison | Harrison, Widgeon |

* Taseko was included in the Summer-run Chilko group in-season, but with the Early Summer Early Miscellaneous group post-season.

Information used for Panel management can be divided into three general categories: (1) pre-season forecasts and expectations, on which pre-season planning activities and the management plan are based; (2) in-season estimates that develop over the course of the season, on which in-season fishery decisions are based; and (3) post-season estimates derived from information that was unavailable during the season, such as spawning ground estimates of escapement, more complete catch estimates, and adjustments to estimates that with hindsight appear to have been biased or incorrect. Key estimates in these categories are summarized in Table 1 and discussed below.

## A. Abundance

End-of-season estimates of run size adopted by the Panel totalled 1,370,000 Fraser sockeye (Table 1), far below pre-season expectations of 10,488,000 fish. Summer-run stocks, on which most fishing opportunities were to be focussed, were affected the most. The impact of low sockeye abundance on Panel decisions about commercial fisheries was severe – there were no Fraser sockeye-directed commercial openings in Panel Areas (nor did Canada pursue such fisheries in non-Panel Areas). Furthermore, in the pink-directed openings that commenced after most sockeye had cleared the fishing areas, non-retention of sockeye was specified in Canadian and U.S. commercial openings except U.S. Treaty Indian openings. The small sockeye by-catch in these Treaty Indian pink-directed fisheries was not sold, but landed as Ceremonial and Subsistence (C&S) catch. The post-season abundance estimate based on accounted catches and spawning ground enumerations was higher than the end-of-season estimate, with a total run-size estimate of 1,637,000 Fraser sockeye (Tables 8 and 9).

The end-of-season estimate of Fraser River pink salmon abundance was 19,500,000 fish. This estimate was revised post-season to 19,993,000 fish, 14% larger than the median forecast of 17,535,000 fish.

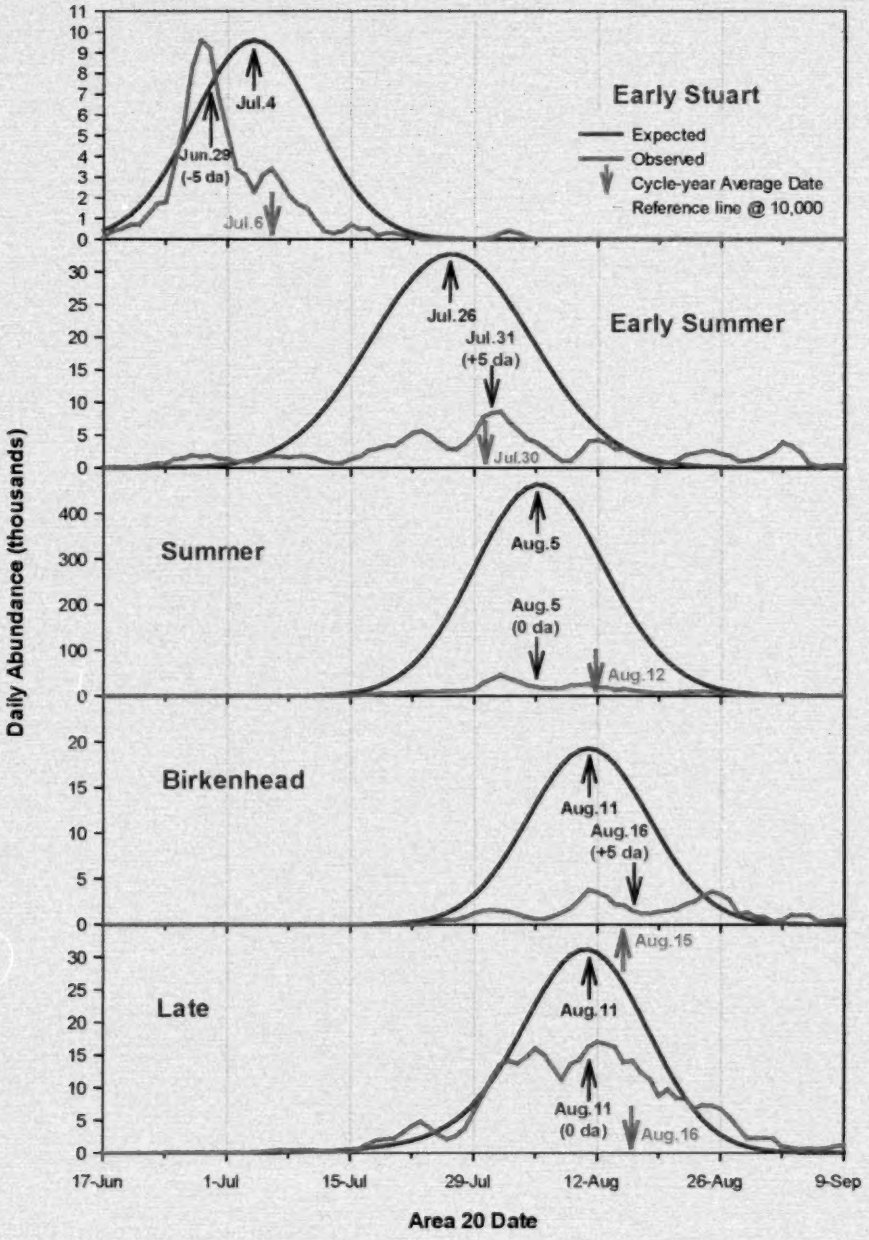


**Figure 3.** Pre-season projections and post-season reconstructions of daily Fraser River sockeye salmon abundance by management group in 2009 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations. The cycle-year average dates are also shown. This figure shows the low abundance of all management groups compared to pre-season expectations.

## B. Migration Timing and Diversion Rate

Figures 3 and 4 show the forecast and observed daily migrations and Area 20 50% migration dates for each sockeye management group and for total Fraser sockeye and pink salmon. Post-season estimates of migration timing in 2009 were: Early Stuart - 5 days earlier than expected, Early Summer - 5 days later than expected, Summer - as projected, and Birkenhead - 5 days later than expected, and Late-run stocks - as projected. Within the Late-run management group, both

Weaver and Harrison sockeye were 2-3 days later than projected. Fraser pink salmon were 3 days later than expected (Figure 4).

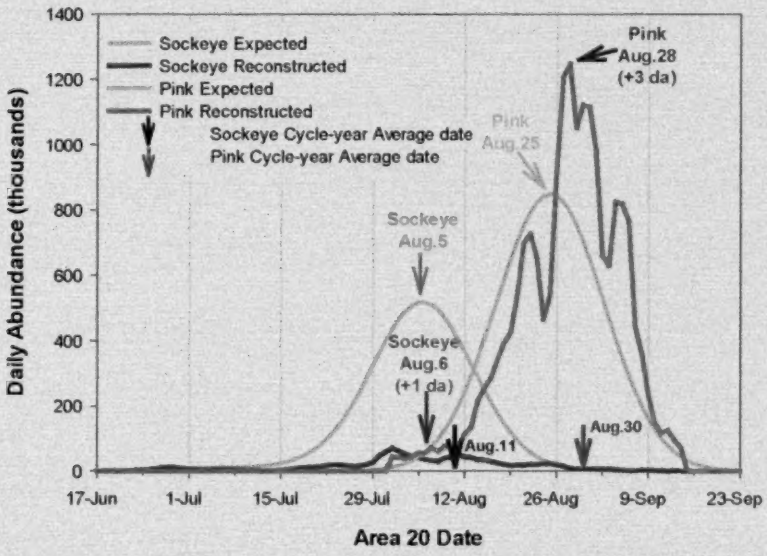


**Figure 4.** Pre-season projections and post-season reconstructions of daily Fraser River sockeye and pink salmon abundance in 2009 (Area 20 date), including the observed 50% date and number of days difference with pre-season expectations. The cycle-year average dates are also shown. This figure shows the low abundance of Fraser sockeye salmon compared to pre-season expectations.

Johnstone Strait diversion rates in 2009 (Figure 5) were higher than forecast for Fraser sockeye (47% compared to 32% forecast) and pink salmon (37% compared to 31% forecast), but for pink salmon was lower than the revised in-season expectation of 47%. The in-season sockeye diversion rate estimate increased from 20-40% in July to 40-80% through August, while the pink estimate decreased from 50-80% to below 20% before increasing briefly at the end of the run.

### C. Management Adjustments and DBEs

Management adjustments or MAs are based on statistical models[6,7,8,9] that consider the historical differences between in-season projections of spawning escapement (i.e., Mission escapement minus catch above Mission, or "potential spawning escapement") and post-season estimates (i.e., spawning ground enumerations). For Early Stuart, Early Summer and Summer-run stocks, the models relate historical differences between estimates (DBEs) to river conditions measured near Hells Gate in the Fraser River. When discharge levels or temperatures are high, DBEs also tend to be high. In addition, for Early Stuart and Early Summer runs, in-season estimates are consistently higher than spawning ground estimates even when migration conditions

[6] Hague, M.J., and Patterson, D.A. 2007. Quantifying the sensitivity of Fraser River sockeye salmon (*Oncorhynchus nerka*) management adjustment models to uncertainties in run timing, run shape and run profile. Can. Tech. Rep. Fish. Aquat. Sci. 2776 : vii + 55p.

[7] Macdonald, J.S., Patterson, D.A., Guthrie, I., Lapointe, M. 2008. Improvements to environmental management adjustment models: SEF final report.

[8] Macdonald, J.S., Patterson, D.A., Hague, M.J., Guthrie, I.C. 2010. Modeling the Influence of Environmental Factors on Spawning Migration Mortality for Sockeye Salmon Fisheries Management in the Fraser River, British Columbia. Transactions of the American Fisheries Society 139:768-782.

[9] Cummings, J.W., Hague, M.J., Patterson, D.A., and Peterman, R.M. 2011. The impact of different performance measures on model selection for Fraser River sockeye salmon. N. Am. J. Fish. Aquat. Sci. 31: 323-334.

are within normal ranges. For Late-run sockeye, historical DBEs are related to the date when half the run has migrated past Mission (i.e., 50% date), which captures the impact of the early migration behaviour observed since the mid 1990s on their migration success.

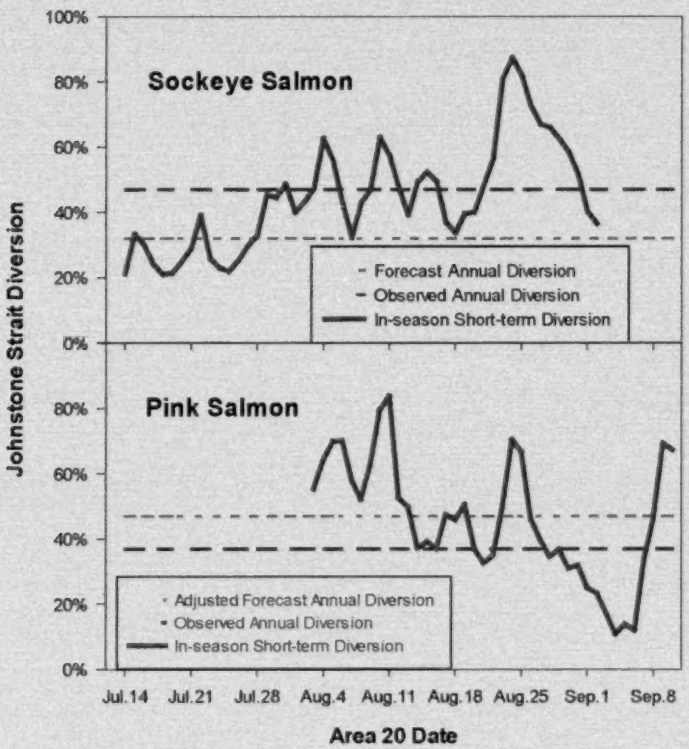


**Figure 5.** Pre-season forecasts of annual Johnstone Strait diversion rates for Fraser sockeye and pink salmon, compared to observed short-term and annual rates. The forecasted pink diversion rate (47%) includes an adjustment for potential bias.

Pre-season MAs and DBEs are based on median values from historical datasets for each management group, or are forecast from long-range forecasts of migration timing and river conditions. In-season values are generated using updated migration timing estimates and a combination of observed and short-range forecasts of river discharge and temperature. Earlier predictions are based on up to 10 days of forecast discharges and temperatures while later predictions are based entirely on observed conditions. In contrast, post-season values are calculated independently of any environmental data using post-season estimates of potential spawning escapement (Mission passage minus catch above Mission) and spawning ground escapement. Post-season values become part of the historical data for MA models in future years.

In 2009, estimates of %DBEs in the in-season and post-season periods were generally of a slightly larger magnitude than forecast (Table 6), with two notable exceptions. First, for Summer-run sockeye the pre-season forecast of a 0% DBE was replaced in-season by an estimate of -22%, close to the post-season estimate of -17%. This reduced the Summer-run TAC. Second, for Late runs the in-season estimate of -86% contrasted with the post-season estimate of +9%. In other words, more fish were estimated on the spawning grounds than the sum of Mission escapements and catch upstream of Mission. This outcome was largely due to a larger than expected spawning escapement of Harrison sockeye (if Harrison is excluded the Late-run DBE is -47% instead of +9%). River temperatures were substantially warmer than usual, especially in late July and early August, while discharge levels were lower than average (Figure 6).

**Table 6.** Pre-season, in-season and post-season estimates of DBEs (differences between estimates) and pMAs (proportional management adjustments). Pre-season predictions are based on long-range forecasts of migration timing and of 31-day mean Fraser River temperature and discharge. In-season estimates reflect the final values adopted by the Panel for in-season management and are based on in-season forecasts of migration timing and 19-day mean river conditions. The observed DBEs are calculated from final in-season estimates of potential spawning escapement and post-season estimates of spawning populations based on field enumeration programs conducted by DFO.

| Description | Early Stuart | | Early Summer | | Summer | | Birkenhead | | Late (excld. Birk.) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | %DBE | pMA | %DBE | pMA | %DBE | pMA | %DBE | pMA | %DBE | pMA |
| Pre-season prediction | -32% | 0.46 | -29% | 0.40 | 0% | 0.00 | 0% | 0.00 | -86% | 6.04 |
| In-season prediction | -28% | 0.38 | -38% | 0.60 | -22% | 0.28 | 0% | 0.00 | -86% | 6.04 |
| Observed [2] | -40% | 0.65 | -49% | 0.95 | -17% | 0.21 | -7% | 0.08 | 9% | -0.08 |

1 Pre-season prediction was for all Lates combined (i.e., Harrison, Birkenhead, Shuswap/Portage and Weaver/Cultus). Harrison was separated from the Late-run during in-season management.

2 Derived from DFO's near-final spawning escapement estimates.

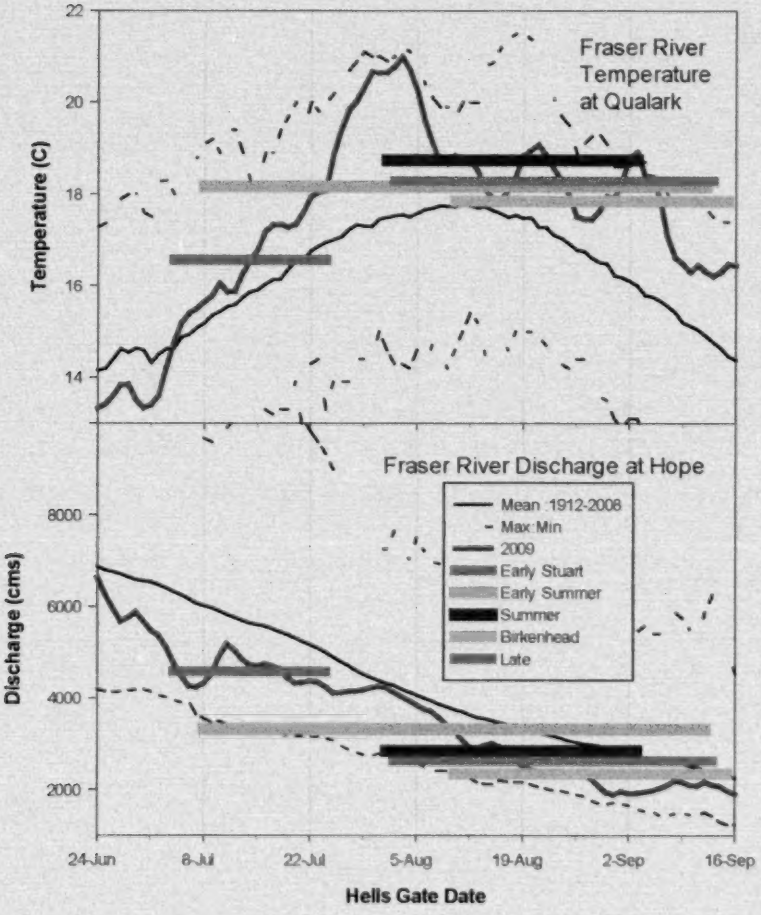


**Figure 6.** Fraser River temperature and discharge measured near Hope in 2009. Also shown are the mean temperature and discharge during the central 90% of the migration of each management group (excluding Pitt).

### D. Mission Escapement

Mission passage estimates totalled 1,304,000 sockeye (95% of the end-of-season estimate of total returns), including 83,000 Early Stuart, 186,000 Early Summer, 616,000 Summer, 67,000 Birkenhead and 351,000 Late-run sockeye (Table 7). Pink salmon passage at Mission was the subject of an experimental program. A post-season reassessment that included data from a near-shore DIDSON (Dual-frequency IDentification SONar ) generated a total Mission passage estimate of 16,152,000 pink salmon (see Appendix G for more details). This direct estimate of Mission passage is very similar to an estimate of 15,658,000 fish, obtained by subtracting all catch seaward of Mission (3,842,000 pinks) from the total run size of 19,500,000 pinks adopted by the Panel.

**Table 7.** Fraser River sockeye and pink salmon passage at Mission in 2009.

| Management Group | Mission Passage | |
|---|---|---|
| Stock Group | fish | % |
| Early Stuart | 82,500 | 6% |
| Early Summer | 186,400 | 14% |
| Chilliwack | 14,300 | 1% |
| Early Miscellaneous | 58,800 | 5% |
| Seymour/Scotch | 18,200 | 1% |
| North Thompson | 62,600 | 5% |
| Pitt | 32,500 | 2% |
| Summer | 616,300 | 47% |
| Chilko | 252,500 | 19% |
| Quesnel | 202,000 | 15% |
| Late Stuart/Stellako | 161,800 | 12% |
| Birkenhead | 67,100 | 5% |
| Late | 351,300 | 27% |
| Late Shuswap/Portage | 52,000 | 4% |
| Weaver/Cultus | 74,100 | 6% |
| Harrison | 225,200 | 17% |
| Total Sockeye | 1,303,600 | 100% |
| Pink Salmon | 16,152,000 | 100% |

## V. RUN SIZE, CATCH AND SPAWNING ESCAPEMENT

Table 8 provides an overview of run size by management group for Fraser sockeye and pink salmon. Included are estimates of catches, spawning escapements and Run-size Adjustments (RSAs)[10]. Table 9 provides similar information, but with more detail on individual sockeye stock groups. Figure 7 shows total sockeye abundance by year, while Figures 9 (sockeye) and 12 (pink) show catch, escapement and exploitation rate by year for a historical perspective. Details of

[10] Run-size Adjustments (RSAs) are additions to the total return in cases when there is evidence that more fish returned than were accounted for in catch and escapement, e.g., evidence of en route mortality, incomplete spawning ground assessments. The focus of RSAs is on providing the best assessments of total returns, i.e., recruitment. Models that relate recruitment and spawning stock are used to develop both pre-season abundance forecasts and escapement policy. Staff work with the Fraser Technical Committee to provide recommendations to the Fraser Panel about how RSAs are assigned and corresponding best estimates of total return. PSC staff, Technical Committee members and DFO staff are collaborating in the development of a formal process and criteria for determining RSAs.

commercial catch distributions of Fraser pinks by area and gear in Canada and the U.S. are provided in Tables 10 and 11. Tables 1 (sockeye) and 2 (pink) in Appendix H show catch by user group, spawning escapement, RSA and total abundance over the last four cycle years, while Tables 3 (sockeye) and 4 (pink) in Appendix H show a geographic breakdown of Canadian First Nations catches. Sockeye salmon spawning escapements since 1938 are summarized by management group in Figure 11, and by stock for the last four cycle years in Table 5 in Appendix H. Table 6 in Appendix H reports production data for Fraser pink salmon since 1961.

In 2009, the return of adult Fraser sockeye was only 15% of the pre-season forecast, which did not allow for sockeye-directed commercial fisheries in either country and restricted First Nations opportunities in Canada. The return of Fraser pink salmon, however, exceeded the forecast by 14% and provided for pink-directed commercial, First Nations and recreational fisheries, subject to constraints imposed to protect Fraser sockeye.

### A. Sockeye Salmon

The total abundance of sockeye salmon in 2009 was 1,590,000 adults (1,637,000 if jacks included, Tables 8 and 9) substantially below the 90% probability level forecast of 3,556,000 fish (Appendix B), only 15% of the median forecast (10,488,000 fish, Table 1) and only 23% of the brood year abundance (7,024,000 adults in 2005). It was the smallest return on the 2009 cycle since records began in the late 1800s, and the second smallest on any cycle since 1947 (Figure 7), although the return of 1,510,000 sockeye in 2007 was only slightly higher. Before 1913-14, when rockslides caused by railway construction severely blocked fish passage at Hells Gate, the 2009 cycle was by far the largest with estimated annual abundances exceeding 20 million and even reaching 40 million fish.

The difference between the pre-season forecast and post-season estimate was concentrated in two Summer-run stocks. The adult returns of both Chilko and Quesnel stocks (303,000 and 204,000 adults, respectively) were only 6-7% of the median forecasts (4,175,000 fish and 3,575,000 fish, respectively), and collectively account for 7,243,000 of the total difference of 8,898,000 adults between forecasted (10,488,000) and observed (1,590,000) abundances.

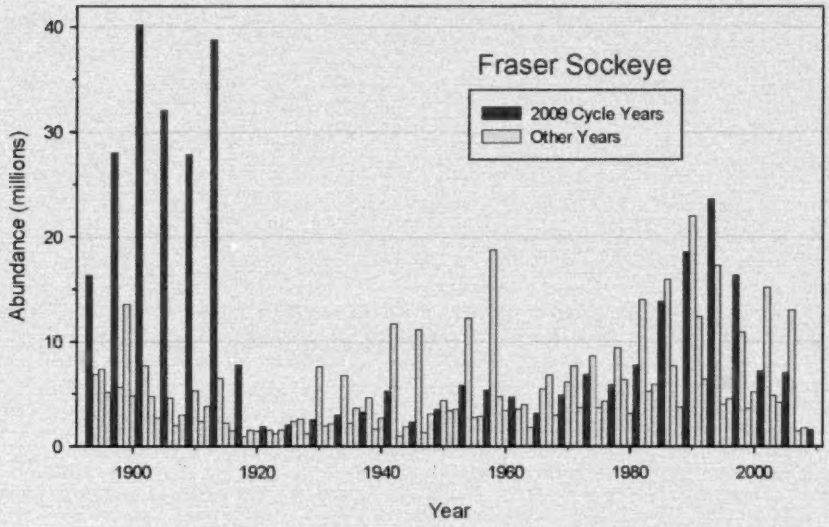


**Figure 7.** Total abundance of Fraser River sockeye salmon in 1893-2009. Returns on the 2009 cycle are emphasized.

**Table 8.** Catch, escapement, run-size adjustment and run size for Fraser River sockeye (by management group) and pink salmon in 2009.

| | Fraser Sockeye | | | | | | | Fraser Pinks | |
|---|---|---|---|---|---|---|---|---|---|
| | Early Stuart | Early Summer | Summer | Birken -head | Late | Total | % of Run | Total | % of Run |
| CANADIAN CATCH | 7,600 | 10,100 | 47,800 | 1,600 | 6,800 | 73,800 | 5% | 1,726,800 | 9% |
| Commercial Catch | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 915,600 | 5% |
| Panel Area | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 75,100 | 0% |
| Non-Panel Areas | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 840,400 | 4% |
| First Nations Catch | 7,500 | 9,800 | 46,500 | 1,500 | 6,500 | 71,800 | 4% | 520,500 | 3% |
| Marine FSC | 100 | 1,400 | 5,100 | 800 | 2,600 | 9,900 | 1% | 10,500 | 0% |
| Fraser River FSC | 7,400 | 8,400 | 41,400 | 700 | 3,900 | 61,900 | 4% | 2,000 | 0% |
| Economic Opportunity | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 508,000 | 3% |
| Non-commercial Catch | 60 | 300 | 1,300 | 60 | 300 | 2,000 | 0% | 290,800 | 1% |
| Marine Recreational * | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 38,600 | 0% |
| Fraser Recreational | 0 | 20 | 0 | 0 | 10 | 30 | 0% | 237,200 | 1% |
| Charter (Albion, Qualark) | 60 | 300 | 1,300 | 60 | 300 | 2,000 | 0% | 2,700 | 0% |
| ESSR | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 12,300 | 0% |
| UNITED STATES CATCH | 200 | 1,800 | 9,900 | 1,400 | 3,900 | 17,200 | 1% | 2,815,600 | 14% |
| **Washington Total** | **0** | **500** | **2,100** | **700** | **1,000** | **4,300** | **0%** | **2,815,600** | **14%** |
| Commercial catch | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 2,793,600 | 14% |
| Treaty Indian | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 1,031,400 | 5% |
| All Citizen | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 1,762,200 | 9% |
| Non-commercial Catch | 0 | 500 | 2,100 | 700 | 1,000 | 4,300 | 0% | 22,000 | 0% |
| Ceremonial | 0 | 500 | 2,100 | 700 | 1,000 | 4,300 | 0% | 1,000 | 0% |
| Recreational | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 21,000 | 0% |
| **Alaska** | **200** | **1,300** | **7,800** | **700** | **2,900** | **12,900** | **1%** | 0 | 0% |
| TEST FISHING CATCH | 1,900 | 5,500 | 15,800 | 1,600 | 7,300 | 32,100 | 2% | 21,800 | 0% |
| **PSC (Panel Areas)** | **1,900** | **4,000** | **8,800** | **900** | **4,800** | **20,400** | **1%** | **18,300** | **0%** |
| Canada | 1,600 | 3,000 | 7,400 | 800 | 4,000 | 16,900 | 1% | 12,500 | 0% |
| United States | 300 | 1,000 | 1,400 | 80 | 800 | 3,500 | 0% | 5,800 | 0% |
| **Canada (non-Panel Areas)** | **50** | **1,500** | **6,900** | **700** | **2,600** | **11,700** | **1%** | **3,500** | **0%** |
| TOTAL RUN | 81,700 | 180,600 | 675,200 | 71,700 | 628,300 | 1,637,400 | 100% | 19,993,000 | 100% |
| Total Catch in All Fisheries | 9,800 | 17,300 | 73,400 | 4,600 | 18,000 | 123,200 | 8% | 4,564,200 | 23% |
| Adult Spawning Escapement ** | 45,300 | 91,600 | 477,700 | 61,600 | 379,500 | 1,055,700 | 64% | 15,428,800 | 77% |
| Jack Spawning Escapement ** | 0 | 2,800 | 4,600 | 200 | 40,300 | 47,900 | 3% | 0 | 0% |
| Run-Size Adjustment | 26,600 | 68,800 | 119,400 | 5,400 | 190,400 | 410,600 | 25% | 0 | 0% |
| **Percentage of Total Run** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | | **100%** | |
| Total Catch in All Fisheries | 12% | 10% | 11% | 6% | 3% | 8% | | 23% | |
| Spawning Escapement | 55% | 52% | 71% | 86% | 67% | 67% | | 77% | |
| Run-Size Adjustment | 33% | 38% | 18% | 7% | 30% | 25% | | 0% | |

* An additional 30 sockeye were caught in marine recreational fisheries in areas other than Barclay Sound, for which no samples exist and stock ID cannot be confirmed.

** Spawning escapement estimate for Cultus sockeye includes 184 adults and 98 jacks captured as brood stock.

**Table 9.** Catch, escapement, run-size adjustment, run size and exploitation rate for Fraser River sockeye (by stock group) and pink salmon in 2009.

| Management Group / Stock Group | Catch [1] | Adult Spawning Escapement | Run-size Adjustment | Abundance Adult | Abundance Jack [2] | Abundance Total | Portion of Run | Adult Exploitation Rate |
|---|---|---|---|---|---|---|---|---|
| **Fraser Sockeye Salmon** | | | | | | | | |
| Early Stuart | 9,800 | 45,300 | 26,600 | 81,700 | 0 | 81,700 | 5% | 12% |
| Early Summer-run | 17,300 | 91,600 | 68,800 | 177,800 | 2,800 | 180,600 | 11% | 10% |
| Chilliwack | 700 | 5,600 | 1,900 | 8,100 | 0 | 8,100 | 0% | 9% |
| Early Miscellaneous | 8,800 | 24,900 | 27,600 | 61,300 | 1,000 | 62,300 | 4% | 14% |
| Seymour/Scotch | 1,400 | 12,500 | 4,300 | 18,200 | 1,800 | 20,000 | 1% | 8% |
| North Thompson | 4,800 | 17,600 | 35,100 | 57,500 | 0 | 57,500 | 4% | 8% |
| Pitt | 1,700 | 31,000 | 0 | 32,700 | 10 | 32,700 | 2% | 5% |
| Summer-run | 73,400 | 477,700 | 119,400 | 670,600 | 4,600 | 675,200 | 41% | 11% |
| Chilko | 36,200 | 213,400 | 53,300 | 302,900 | 4,400 | 307,300 | 19% | 12% |
| Quesnel | 17,500 | 149,600 | 37,400 | 204,500 | 70 | 204,500 | 12% | 9% |
| Late Stuart/Stellako | 19,700 | 114,800 | 28,700 | 163,200 | 100 | 163,300 | 10% | 12% |
| Birkenhead | 4,600 | 61,600 | 5,400 | 71,500 | 200 | 71,700 | 4% | 6% |
| Late-run | 18,000 | 379,500 | 190,400 | 587,900 | 40,300 | 628,300 | 38% | 3% |
| Late Shuswap/Portage | 5,400 | 34,300 | 27,800 | 67,500 | 38,900 | 106,400 | 6% | 8% |
| Weaver/Cultus [3] | 5,800 | 36,400 | 75,600 | 117,800 | 1,300 | 119,100 | 7% | 5% |
| Harrison | 6,700 | 308,800 | 87,100 | 402,600 | 200 | 402,800 | 25% | 2% |
| Total | 123,200 | 1,055,700 | 410,600 | 1,589,500 | 47,900 | 1,637,400 | 100% | 8% |
| Portion of Total Run | 8% | 64% | 25% | 97% | 3% | 100% | | |
| **Fraser Pink Salmon** | | | | | | | | |
| Total | 4,564,200 | 15,428,800 | 0 | 19,993,000 | 0 | 19,993,000 | | 23% |
| Portion of Total Run | 23% | 77% | - | 100% | | | | |

1 An additional 30 sockeye were caught in marine recreational fisheries in areas other than Barclay Sound, for which no samples exist and stock ID cannot be confirmed.

2 Jack ratio's were not estimated for fisheries; estimates include only those jacks that were actually sampled and are therefore underestimates.

3 Spawning escapement estimate for Cultus sockeye includes 184 adults and 98 jacks captured as brood stock.

The total return of Early Stuart sockeye was 82,000 adults (Tables 8 and 9), or 49% of the 75p forecast adopted pre-season by the Panel. Early Summer returns totalled 178,000 adult sockeye, 24% of the forecast. The largest Early Summer stock components were Early Miscellaneous (61,000 fish) and North Thompson (58,000 fish) stocks. The abundance of Summer-run sockeye was 671,000 adults, or 8% of the pre-season forecast. For Birkenhead sockeye, the total abundance of 72,000 adults was 21% of the pre-season forecast. The return of 588,000 adult Late-run sockeye was 3% higher than the pre-season forecast.

The very low returns in 2009 raised concerns about the state of Fraser sockeye and resulted in the Government of Canada establishing the "Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River", otherwise known as the Cohen Commission. The Cohen

Commission's final report[11], "The Uncertain Future of Fraser River Sockeye", was released to the public on October 31, 2012.

Also out of concern about the recent declines in the abundance and productivity of Fraser River sockeye salmon, the Pacific Salmon Commission directed Staff to convene a bilateral scientific workshop of fisheries experts to evaluate evidence for and against possible causes of these declines. An Expert Advisory Panel was created, composed of 11 experienced researchers from Washington and British Columbia, and a workshop was held on June 15-17, 2010 in Nanaimo. The Expert Advisory Panel authored a report of their findings[12], which is posted on the PSC website (www.psc.org). Among the information presented was evidence of decreased productivity of Fraser sockeye since the early 1990s (Figure 8), culminating in the record low productivity observed for the 2009 return. The main conclusion of the Expert Advisory Panel was that unfavorable oceanographic conditions (physical and biological) in the Strait of Georgia during the juvenile life stage of Fraser sockeye was very likely the major cause of the poor survival of the cohort that returned in 2009. Further, such conditions in the Strait are likely the major cause of the long-term decrease in productivity that has occurred since the late 1980s and early 1990s for most Fraser sockeye stocks. Similar physical and biological conditions were also judged to affect the survival of Fraser sockeye outside of the Strait of Georgia, but to a lesser degree.

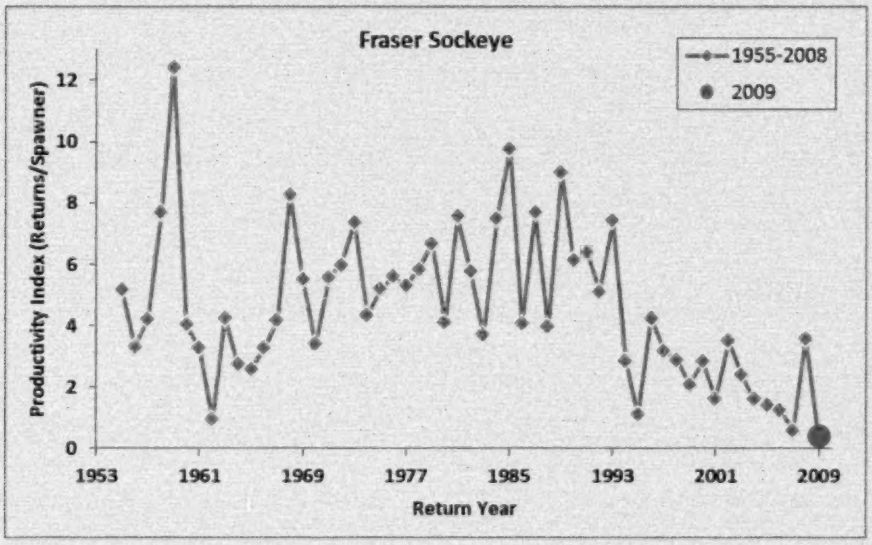


**Figure 8.** Historical productivity of Fraser River sockeye salmon, measured as the total return each year divided by the total number of spawners four years previous.

The total catch of 123,000 fish was about 8% of the run (Tables 8 and 9), the lowest observed since records began in the late 1880s. This exploitation rate is very low, even given the trend towards lower exploitation rates observed since the mid 1990s (Figure 9) following Canada's rebuilding strategy and conservation concerns for Late-run sockeye and other stocks. Of the total catch, 74,000 fish were caught in Canada, 17,000 fish in the U.S. and 32,000 fish in test fisheries. Almost all the Canadian catch was taken in First Nations fisheries, while the Canadian commercial catch was zero due to the complete absence of commercial openings in 2009. Washington State fishers caught only 4,300 Fraser sockeye as by-catch in pink-salmon directed Treaty Indian fisheries, and these were used for Ceremonial and Subsistence purposes. Approximately 13,000 Fraser sockeye were incidental catch in commercial fisheries in Alaska.

[11] Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River (Canada). The Uncertain Future of the Fraser River Sockeye. Final report. Bruce I. Cohen, Commissioner. 2012.

[12] Peterman R.M., D. Marmorek, B. Beckman, M. Bradford, N. Mantua, B.E. Riddell, M. Scheuerell, M. Staley, K. Wieckowski, J.R. Winton, C.C. Wood. 2010. Synthesis of evidence from a workshop on the decline of Fraser River sockeye. June 15-17, 2010. A Report to the Pacific Salmon Commission, Vancouver, B.C.

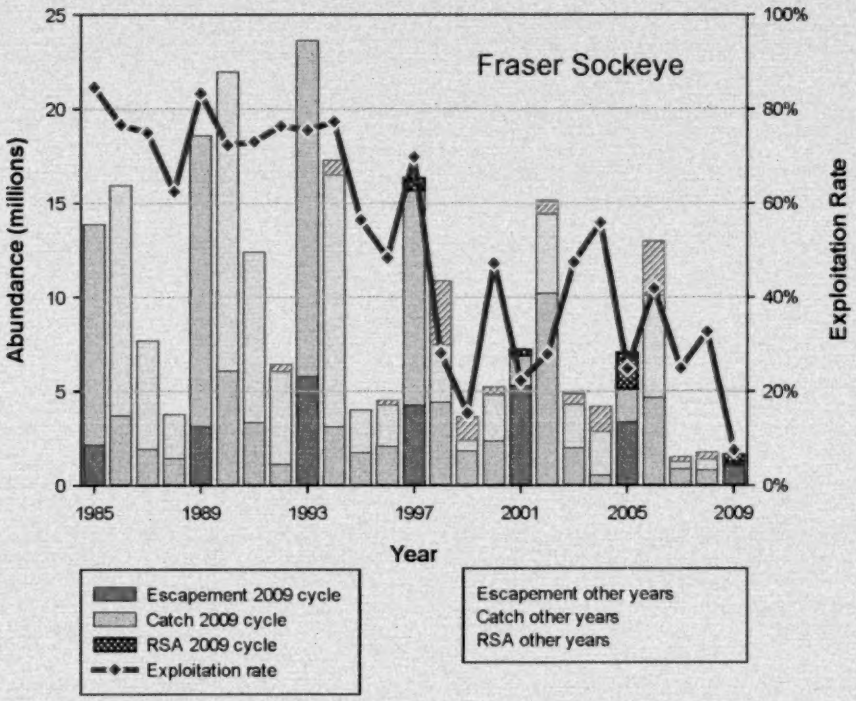


**Figure 9.** Total abundance, catch, escapement, run-size adjustment and exploitation rate for Fraser River sockeye salmon in 1985-2009, with returns on the 2009 cycle emphasized.

DFO annually assesses the abundance of sockeye spawning populations in the Fraser watershed (Figure 10). In 2009, the near-final estimate of adult spawners (primarily age 4 and age 5 fish) totalled 1,056,000 fish, or 64% of the total run. This escapement was 32% of the brood year (2005) escapement of 3,308,000 adults and similar to cycle line escapements in the 1949-1981 period.

Reduced escapements relative to the brood year were observed across most management groups, but in particular the adult Summer-run escapement was only 19% of the brood year escapement. All streams in the Quesnel system were assessed (150,000 fish) in 2009, in contrast to the brood year (2005) when only a fraction of Quesnel populations were assessed (Mitchell River and many other Quesnel Lake tributaries were omitted). Nearly all assessed sockeye populations in the Quesnel system experienced significant reductions in spawning escapement. The 71,000 fish that escaped to the Horsefly River and Channel in 2009 was only 11% of the brood year escapement of 658,000 fish.

The escapement to Chilko River totalled 213,000 fish, 40% of the brood year escapement and also far below the pre-season forecast. The estimated outmigration of Chilko smolts in 2007 was 77,000,000 smolts, nearly double the previous record of 40,000,000 smolts, and substantially higher than the long-term (1951-2006) average of 16,000,000 smolts. Due to the high abundance and larger than average body size of Chilko smolts, expectations for adults returns in 2009 were positive, even though recent smolt-to-adult survival rates were poor. The smolt-to-adult survival rate of 0.3% for the 2009 return was unprecedentedly poor, however, and only one quarter of the previous 50-year minimum value of 1.2% that was associated with the return in 2007.

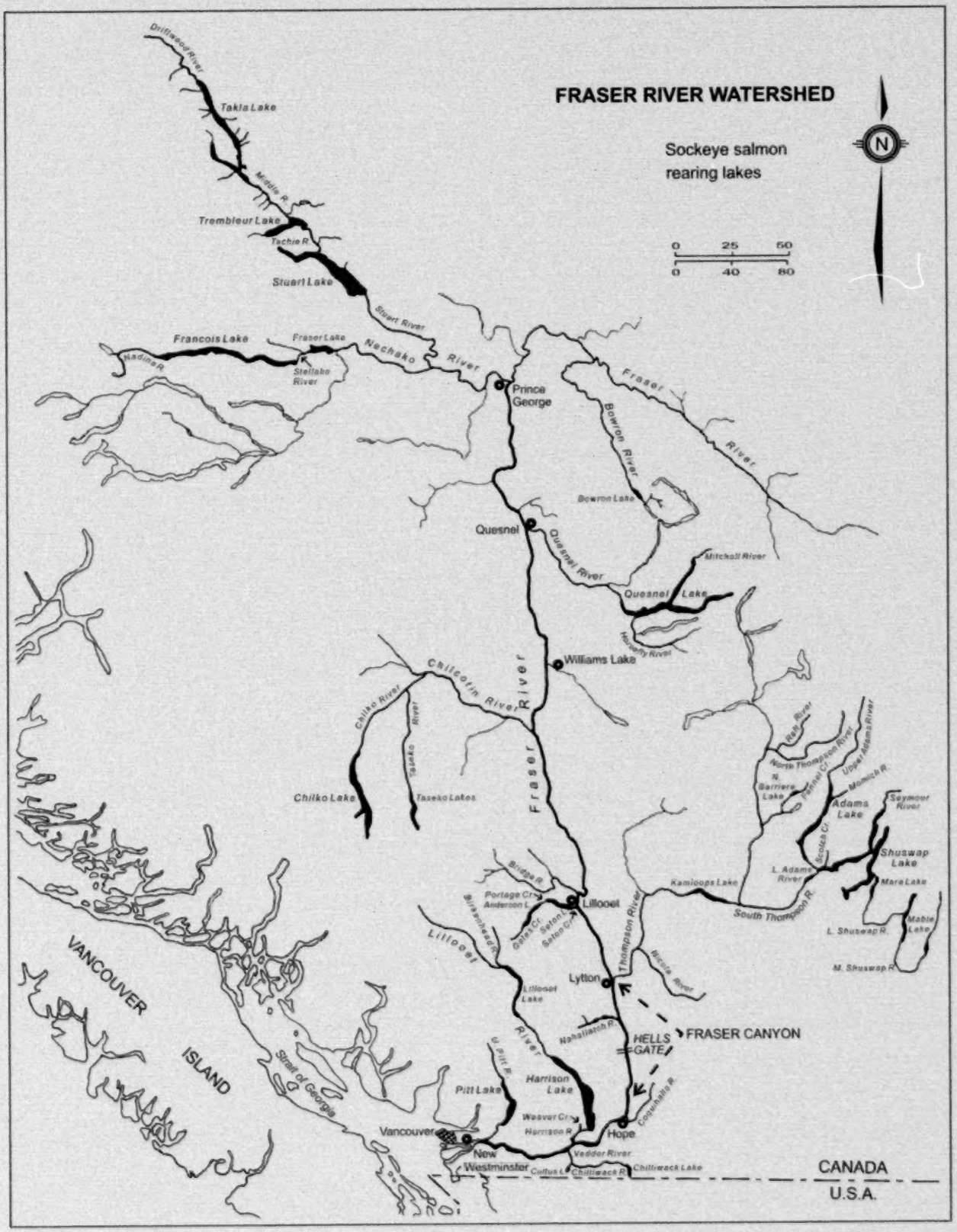


**Figure 10.** Sockeye salmon spawning areas in the Fraser River watershed.

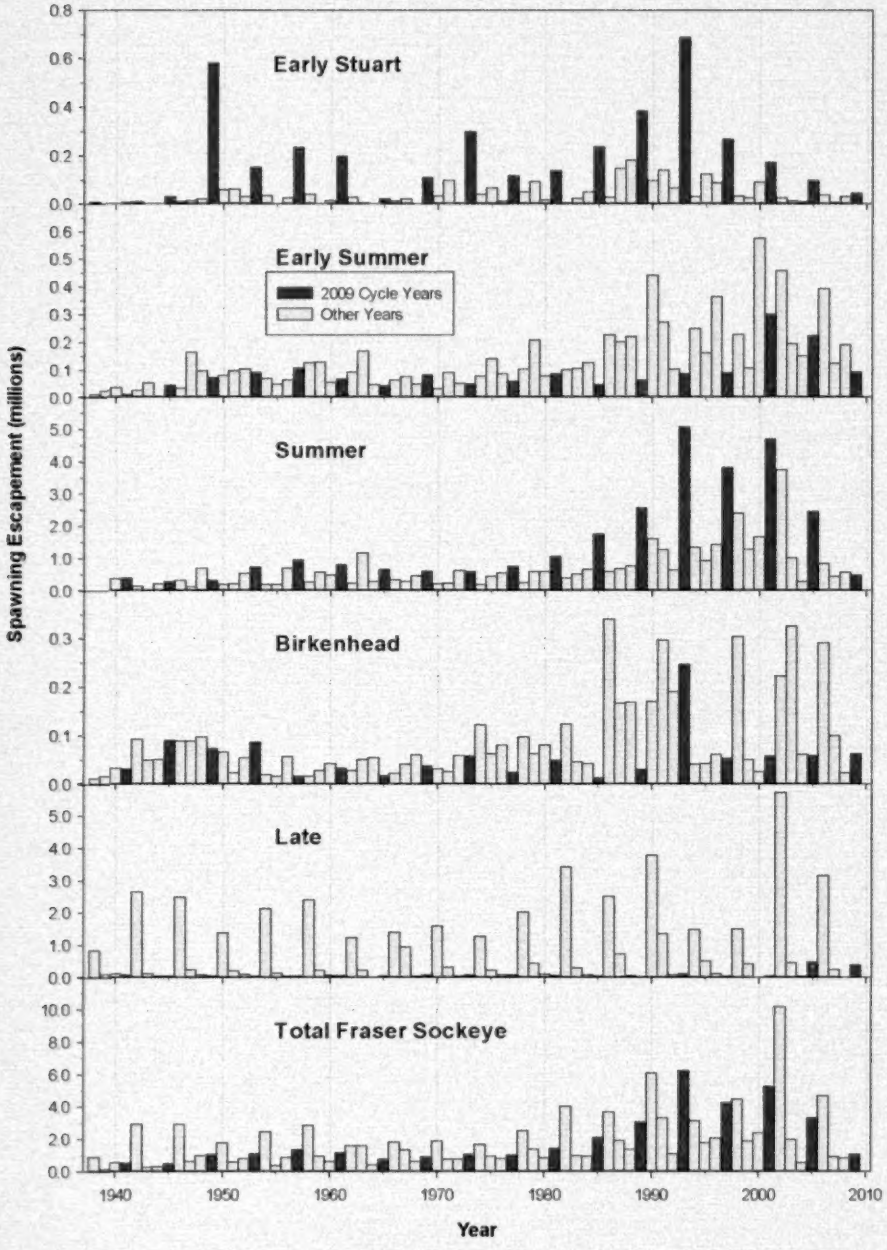


**Figure 11.** Adult spawning escapement of Fraser River sockeye salmon for each management group and for total sockeye in 1938-2009, with escapements on the 2009 cycle emphasized.

Escapements of Late-run sockeye to the Harrison River were very strong in 2009. The escapement of 307,000 fish was the second largest escapement to the Harrison River on record, with the record being the 2005 brood year escapement of 389,000 fish. Production from the large 2005 escapement was low, however. For example, 299,000 of the 2009 Harrison River spawning estimate were estimated to be 3-year-olds from the 2006 brood year and only 8,000 were age 4 fish from the 2005 brood year (the return of age 3 sockeye from the 2005 brood year, in 2008, was also low). Spawning success for adult females in the Harrison River was 94% in 2009. As in some recent years, the estimated spawning escapement of Harrison sockeye exceeded the escapement past Mission.

A long term view shows that escapements on the 2009 cycle have historically been low for Early Summer and Late-run sockeye, and strong for Early Stuart and Summer-run stocks (Figure 11). In a historical cycle-line context, spawning escapements in 2009 represent the: (1) lowest to the Early Stuart system since 1965; (2) lowest Early Summer escapement since 1997; (3) lowest Summer-run escapement since 1949; (4) similar to recent cycle years for Birkenhead sockeye; and (5) second largest Late-run escapement on record.

The timing of peak spawning activity was consistent with historical observations for all management groups. Due to low levels of summer and early autumn precipitation, extremely low water conditions restricted fish access to several spawning tributaries in the Quesnel, mid-Fraser, and Shuswap regions.

The overall spawning success of adult female sockeye in the Fraser watershed was 96%. The effective female spawning population in 2009 totalled 514,000 fish, which was approximately 34% of the effective female escapement in 2005.

The RSA estimate of 411,000 fish is 25% of the total return. As a percentage of each management groups' run size, Early Stuart, Early Summer and Late groups had the largest RSAs (33%, 38% and 30%, respectively), while the other groups had RSAs of 18% or less. The methods for determining RSAs are under review by PSC and DFO staff, and the Fraser Technical Committee.

### B. Pink Salmon

The post-season estimate of Fraser pink salmon run size is 19,993,000 fish (Tables 8 and 9), 14% larger than the median forecast and the 4$^{th}$ largest since at least 1959. Advancements in the PSC's hydroacoustic program made 2009 the first year in which direct in-river estimates of pink salmon migration past Mission was possible. The post-season run-size estimate was calculated by adding the total catch of Fraser pink salmon below Mission (3,842,000 fish) to the Mission passage estimate (16,151,000 fish). Spawning escapement (15,429,000 fish) was estimated by subtracting the total catch in all fisheries (4,564,000 fish) from the run-size estimate.

Returns of Fraser pink salmon (Figure 12) have shown large variation in recent years, with the lowest return since 1965 occurring in 1999 (3,617,000 fish), followed four years later by the highest return (26,000,000 fish) since records began in 1959. The 2009 return was substantially higher than average and the fourth largest since at least 1959.

The exploitation rate of Fraser River pink salmon in 2009 was 23%, higher than the low exploitation rates (5-10%) observed from 1999 to 2007, but much lower than the 1959-1997 average exploitation rate of 63% (Figure 12). The low exploitation rates observed in recent years are partly due to conservation concerns for Late-run sockeye that co-migrate with pink salmon, but also reflect the impact of low consumer demand and market value for pink salmon, rising fuel costs and larger abundances of Fraser River pink salmon. These low harvest levels have resulted in substantial spawning escapements of Fraser pinks in recent years. The exploitation rate in 2009 reflects a higher level of effort applied to pink-directed fisheries than observed in recent years. The additional effort was due to increased interest in catching pink salmon (an outcome of the lack of sockeye opportunities, improved prices for pink salmon and very poor pink catches in northern fisheries), combined with enough separation between Fraser sockeye and pink migrations to make pink-directed fisheries feasible while respecting sockeye conservation objectives. The result was the largest pink catch since 1997 and the fourth largest spawning escapement on record.

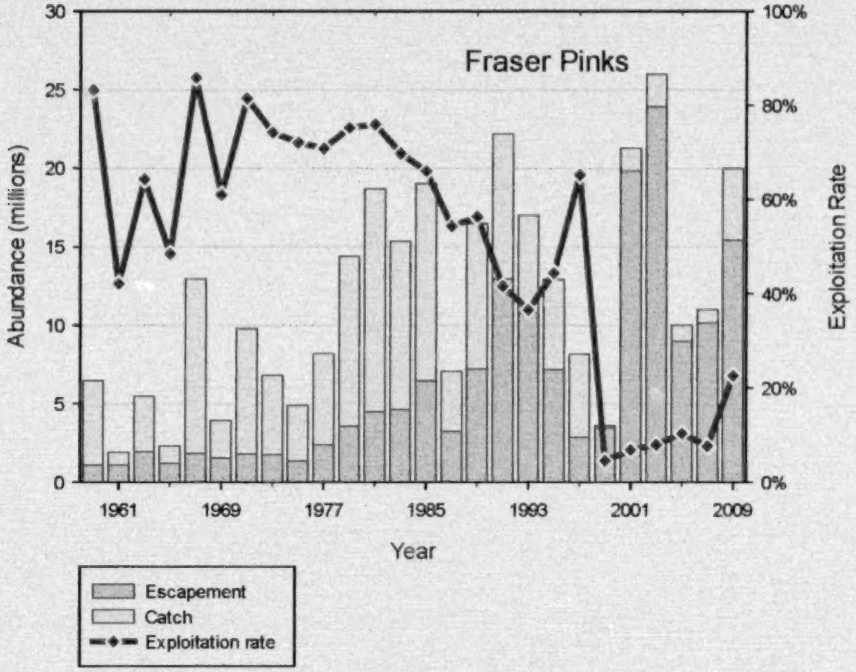


**Figure 12.** Total abundance, catch, escapement and exploitation rate for Fraser River pink salmon in 1959-2009.

Of the total Fraser River pink salmon catch, 1,727,000 fish were caught in Canada, 2,816,000 fish in the U.S. and 22,000 fish in test fisheries (Table 8). The Canadian catch included a commercial catch of 916,000 fish (Table 10), First Nations catch of 521,000 fish (mostly in Economic Opportunity fisheries), recreational catch of 276,000 fish and ESSR catch (Excess Salmon to Spawning Requirements) of 12,000 fish. The U.S. catch included a commercial catch of 2,794,000 fish (Table 11), recreational catch of 21,000 fish and ceremonial catch of 1,000 fish.

**Table 10.** Canadian commercial catches of Fraser River pink salmon by gear type, license designation and statistical area in 2009. Grey areas indicate fishery areas that are not part of the license-area designation.

| Fishery | Purse Seine | | Gillnet | | | Troll | | | |
|---|---|---|---|---|---|---|---|---|---|
| Areas | Area A | Area B | Area C | Area D | Area E | Area F | Area G | Area H | Total |
| Commercial | 0 | 906,100 | 0 | 500 | 0 | 0 | 10 | 8,990 | 915,600 |
| **Panel Areas** | **0** | **75,000** | **0** | **0** | **0** | **0** | **0** | **190** | **75,100** |
| 20 | | 0 | | | 0 | | 0 | | 0 |
| 17, 18, 29 | | 75,000 | | | 0 | | | 190 | 75,190 |
| 121-124 * | | 0 | | 0 | | | 0 | | 0 |
| **Non-Panel Areas** | **0** | **831,100** | **0** | **500** | **0** | **0** | **10** | **8,800** | **840,400** |
| 1-10 | 0 | | 0 | | | 0 | | | 0 |
| 11-16 | | 831,100 | | 500 | 0 | | 0 | 8,800 | 840,400 |
| 124-127 * | | 0 | | 0 | | | 10 | | 10 |
| First Nations Economic Opportunity and Demo Fisheries | | | | | | | | | 508,000 |
| Total Catch | | | | | | | | | 1,423,600 |

* Catch in Area 124 is divided between Panel and Non-Panel Areas.

**Table 11.** U.S. commercial catches of Fraser River pink salmon by user group, gear type and statistical area in 2009. *

| Areas | Troll | Purse Seine | Gillnet | Reefnet | Total |
|---|---|---|---|---|---|
| Panel Area (Washington | 0 | 2,696,000 | 2,000 | 96,000 | 2,794,000 |
| **Treaty Indian *** | **0** | **1,031,000** | **0** | **0** | **1,031,000** |
| 4B, 5 and 6C | 0 | 0 | 0 | 0 | 0 |
| 6 and 7 | 0 | 889,000 | 0 | 0 | 889,000 |
| 7A | 0 | 142,000 | 0 | 0 | 142,000 |
| **All Citizen **** | **0** | **1,665,000** | **1,000** | **96,000** | **1,762,000** |
| 7 | 0 | 881,000 | 1,000 | 96,000 | 978,000 |
| 7A | 0 | 784,000 | 1,000 | 0 | 785,000 |
| Non-Panel Area | | | | | 0 |
| United States Total | | | | | 2,794,000 |

* Estimates for Treaty Indian fisheries are from the "TOCAS" database.

** Estimates for All Citizen fisheries are from the WDFW "LIFT" database.

# VI. ACHIEVEMENT OF OBJECTIVES

The mandate of the Fraser River Panel is to manage fisheries in Panel Area waters to achieve a hierarchy of objectives. In order of importance, the objectives are to: (1) achieve spawning escapement targets for Fraser River sockeye and pink salmon that are set by Canada; (2) achieve targets for international sharing of the TAC as defined in the Treaty; and (3) achieve domestic catch allocation goals within each country. In addition, the Panel must consider conservation concerns for other stocks and species of salmon when planning and conducting fisheries. Panel management is evaluated after each season to determine whether the goals were achieved and to identify potential improvements in data collection programs, assessment methods and management techniques. While not formally under Panel control, management of Canadian non-Panel fisheries directed at Fraser River sockeye and pink salmon is based on the same in-season information and hierarchy of objectives, with priority given to First Nations FSC (Food, Social and Ceremonial) harvest within Canada's allocation.

## A. Spawning Escapement

The Panel's first task is to achieve spawning escapement targets as specified by Canada. Spawning escapement targets for Early Stuart, Early Summer and Summer-run sockeye were determined by applying Canada's spawning escapement plan to abundance estimates for each management group. The objective (as a percentage of abundance) established for Summer-run sockeye was also applied to Birkenhead sockeye. For Late-run sockeye, a maximum exploitation rate of 20% was employed, leaving a nominal escapement target of 80% of the total run. In practical terms, some portion of the Late-run escapement was expected to die en route due to the early migration behaviour observed in recent years, and so fewer spawners than the nominal target were expected to reach the spawning grounds.

In-season monitoring of the progress toward spawning escapement targets is not directly measureable because in most cases spawner abundance cannot be assessed on the spawning grounds until well after the fishing season has ended. In-season management is therefore based on targets for potential spawning escapement (PSE), which include MAs in addition to spawning escapement targets, and can be monitored in-season. As the season progresses these PSE targets are compared against in-season PSE estimates, which are calculated as Mission escapements to date minus First Nations and recreational catches above Mission.

Based on final in-season PSE estimates, in-season PSE targets were achieved for Early Summer (1% over), Birkenhead sockeye (40% over) and Late-run sockeye (9% over, Table 12).

The in-season PSE estimates fell short of the targets for Early Stuart (11% under) and Summer-run stocks (10% under). In the case of Early Stuart, the shortfall was almost entirely due to catch in First Nations and test fisheries, while for Summer-run sockeye the shortfall was largely due to reductions in the available harvest (Table 1) after about half of the catch was taken and to by-catch after the available harvest dropped to zero. Overall, PSE estimates were only 2% less than the in-season target. This result indicates a success for Panel in-season decision-making in that the low sockeye abundance was recognized early (Figure 13), so all sockeye-directed fisheries under Panel management remained closed throughout the season.

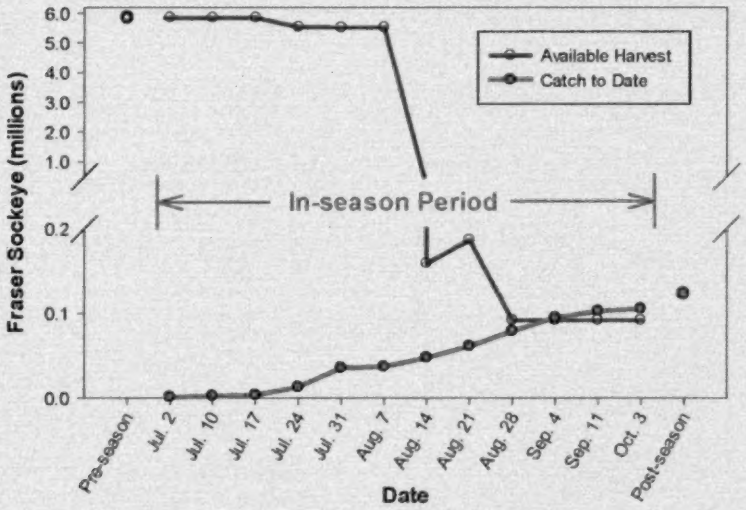


**Figure 13.** Available harvest of Fraser sockeye compared to catch to date in all fisheries in 2009. The available harvest is calculated as run size minus spawning escapement target and management adjustment, and represents fish that are available for catch in all commercial, recreational, First Nations and test fisheries.

**Table 12.** Comparison of in-season targets and in-season estimates of potential spawning escapement (PSE) for adult Fraser River sockeye salmon in 2009.

| | Final | Potential Spawning Escapement (PSE) | | | | | |
|---|---|---|---|---|---|---|---|
| | In-season | Spawning | | In-season | In-season | | |
| Management | Abundance | Escapement | Management | PSE ** | PSE *** | Difference | |
| Group | Estimate | Target | Adjustment * | Target | Estimate | Fish | % |
| **Adult sockeye** | **1,370,000** | **1,148,000** | **282,900** | **1,278,000** | **1,251,000** | **-27,000** | **-2%** |
| Early Stuart | 85,000 | 85,000 | 32,300 | 85,000 | 76,000 | -9,000 | -11% |
| Early Summer | 175,000 | 175,000 | 105,000 | 175,000 | 176,000 | 1,000 | 1% |
| Summer | 650,000 | 520,000 | 145,600 | 650,000 | 584,000 | -66,000 | -10% |
| Birkenhead | 60,000 | 48,000 | 0 | 48,000 | 67,000 | 19,000 | 40% |
| Late | 400,000 | 320,000 | na | 320,000 | 348,000 | 28,000 | 9% |

* Adjustment of spawning escapement targets to achieve spawning escapement goals. If the spawning escapement target + MA exceeds the total abundance, then the target equals the total abundance.

** Spawning escapement target + MA.

*** Mission passage minus all catch above Mission.

In terms of the achievement of post-season objectives, the total spawning escapement of Fraser sockeye was below (21% under) the post-season spawning escapement target, while the target for Fraser pink salmon was exceeded by a considerable margin (157% over, Table 13).

For Early Stuart, the post-season spawning escapement target was effectively the entire run. Thus, any catch or en route loss resulted in an escapement below the target level. The shortfall of 37,000 fish on the spawning grounds is explained by the observed DBE of -40% (Table 6) and catch of about 10,000 fish (Table 9).

The situation for Early Summer stocks was similar in that the spawning escapement target (177,000 fish) was almost the entire run (181,000 fish, Table 13). The escapement shortfall of 85,000 fish can be attributed to the observed DBE of -49% and catch of 17,000 fish. Additional fish may have escaped up-river if the in-season MA estimate (DBE = -38%) had more accurately predicted the observed value and a higher MA had been adopted. However, even if the catch had been zero, the run size needed to be at least 344,000 salmon to achieve the spawning escapement target given the observed DBE.

**Table 13.** Comparison of post-season spawning escapement targets and escapement estimates for adult Fraser River sockeye and pink salmon in 2009. Post-season estimates of sockeye escapement are from spawning ground enumeration programs (DFO), while pink salmon escapement was estimated by subtracting total catch from the post-season run-size estimate.

| Management Group | Post-season Abundance Estimate | Spawning Escapement | | | |
|---|---|---|---|---|---|
| | | Post-season Target | Adult Estimate | Difference Fish | Difference % |
| Sockeye salmon | 1,637,000 | 1,337,000 | 1,056,000 | -281,000 | -21% |
| Early Stuart | 82,000 | 82,000 | 45,000 | -37,000 | -45% |
| Early Summer | 181,000 | 177,000 | 92,000 | -85,000 | -48% |
| Summer | 675,000 | 520,000 | 478,000 | -42,000 | -8% |
| Birkenhead | 72,000 | 55,000 | 62,000 | 7,000 | 13% |
| Late | 628,000 | 503,000 | 379,000 * | -124,000 | -25% |
| Pink salmon | 19,993,000 | 6,000,000 | 15,429,000 | 9,429,000 | 157% |

* Spawning escapement estimate for Late-run Cultus sockeye includes 184 adults captured as brood stock.

For Summer-run sockeye, the run size was sufficiently large to achieve the escapement target given the observed DBE (-17%), which was slightly smaller than the in-season estimate (-22%). The 42,000 fish escapement shortfall was therefore due to the catch of 73,000 fish.

The spawning escapement of Birkenhead sockeye exceeded the target by 13%. Escapement targets for Birkenhead sockeye are set in-directly, by applying the Summer-run TAM rule from Canada's spawning escapement plan to Birkenhead. No MA was applied to Birkenhead because an approach has not yet been developed.

The nominal Late-run escapement target was not achieved (25% under), despite the fact that the in-season PSE target was exceeded (Table 12), the harvest rate was only 3% and well under the 20% limit (Tables 14 and 8), and the observed DBE was +9% (Table 6). This result stems from an assessed RSA[10] of 190,000 Late-run fish, which generated a large post-season increase in the run-size estimate and a corresponding increase in the spawning escapement target.

**Table 14.** Comparison of total Late-run sockeye catch to the 20% exploitation rate limit in 2009.

| Item | % of Run | Fish |
|---|---|---|
| Late-run Abundance (adults, post-season) | | 587,900 |
| Exploitation rate limit | 20% | 117,600 |
| Catch | 3% | 18,000 |
| Deviation | -17% | -99,600 |

## B. International Allocation

The Panel's second priority is to achieve the goals for international allocation of the TACs for Fraser sockeye and pink salmon. In accordance with Annex IV, Chapter 4 of the Pacific Salmon Treaty[1] the February 15, 2008 Commission Guidance[2], the TAC calculations are based on the run sizes, spawning escapement target and MAs in effect when the Panel relinquished control of the last U.S. Panel Area (October 3). Also, because the First Nations catch of Fraser sockeye in Canada was less than the treaty-defined Aboriginal Fishery Exemption (AFE) of 400,000 fish, the AFE was redefined as the greater of either the post-season catch or available AFE by sockeye management group, as represented in the detailed TAC calculation in Appendix H, Table 7.

With the total abundance estimate of 1,370,000 Fraser sockeye, minus deductions for spawning escapement, MA, test fishing catch and AFE, the TAC in 2009 was zero sockeye (Table 15). The Treaty-defined AFE of 400,000 fish was reduced to 147,000 fish, according to the rule specified above. Because the sockeye TAC was zero, the Washington catch of 4,300 sockeye represents a catch overage requiring payback to Canada in future years (Table 19). Canada's catch of 74,000 sockeye was 73,000 fish less than their share of the TAC and AFE combined.

In contrast, the TAC for Fraser pink salmon was 13,478,000 fish, with a U.S. share of 3,464,000 fish and Canadian share of 10,014,000 fish (Table 15). Both countries caught far less than their respective shares, with the U.S. catching 648,000 fish under their share and Canada 8,300,000 fish under.

## C. Domestic Allocation

The third priority of the Panel is to achieve domestic allocation goals as specified by the Parties. While the Panel manages all commercial fisheries directed at Fraser River sockeye and pink salmon in Panel Area waters (Figure 1), Canada has sole responsibility for regulating several of its fisheries including commercial net and troll fisheries in non-Panel areas such as Johnstone Strait, and First Nations and recreational fisheries in all fishing areas. Thus, achievement of Canadian domestic allocation goals requires coordination between Panel and non-Panel regulatory actions.

Given the very low by-catch of Fraser sockeye in Washington (all designated as Ceremonial and Subsistence catch in Treaty Indian fisheries), and the absence of sockeye-directed commercial fisheries in Canada, the achievement of domestic sockeye allocations cannot be assessed here.

With respect to domestic allocations of Fraser pink salmon, Treaty Indian fishers in the U.S. caught 648,000 fish less than their share of the TAC, while All Citizen fishers caught 51,000 fish more (Table 16). In Canada, Area B seines exceeded their respective shares by 265,000 fish, while Area D and E gillnets, and Area G and H trollers were under (Table 17).

**Table 15.** Total allowable catch (TAC) and international catch shares for Fraser River sockeye and pink salmon in 2009. TAC calculations use the in-season estimates of run size, spawning escapement target and management adjustment at the time the Panel relinquished control of the last U.S. Panel Area (October 3), in accordance with Annex IV of the Treaty and the February 15, 2008 Commission Guidance.

| | | Sockeye | | Pink | |
|---|---|---|---|---|---|
| **TOTAL ALLOWABLE CATCH** | | | | | |
| **In-season Total Run Size** | | **1,370,000** | | **19,500,000** | |
| **Deductions** | | **1,609,800** | | **6,021,800** | |
| In-season Spawning Escapement Target | | 1,148,000 | | 6,000,000 | |
| In-season Management Adjustment | | 282,900 | | n/a | |
| Aboriginal Fishery Exemption (AFE) | | 146,800 | | n/a | |
| Post-season Test Fishing Catch | | 32,100 | | 21,800 | |
| **Total Allowable Catch** | *1, 2* | **0** | | **13,478,200** | |
| **UNITED STATES** | | | | | |
| **Washington Share** | | **0** | | **3,463,900** | |
| Washington Share of TAC | *1, 3* | 0 | 16.5% | 3,463,900 | 25.7% |
| Payback | | 0 | | 0 | |
| **Washington Catch** | | **4,300** | | **2,815,600** | |
| **Deviation** | | **-4,300** | | **648,300** | |
| In-season Alaska Catch Estimate | | 0 | | 0 | |
| **CANADA** | | | | | |
| **Canadian Share of TAC + U.S. Payback + AFE** | | **146,800** | | **10,014,300** | |
| **Canadian Catch excluding ESSR Catch** | | **73,800** | | **1,714,500** | |
| **Deviation** | | **73,000** | | **8,299,800** | |

1 TAC and Washington sockeye share according to Annex IV of the Pacific Salmon Treaty and Feb. 15, 2008, Commission Guidance.

2 TAC may not equal the total run minus total deductions shown due to adjustments required when the run size of individual management groups is less than the nominal deductions. A more detailed TAC calculation showing these intermediate calculations is shown in Table 7 in Appendix H.

3 United States share according to revised Annex IV of the Pacific Salmon Treaty:
Sockeye: 16.5% of the TAC - payback (maximum 5% of share).
Pink: 25.7% of the TAC - payback (maximum 5% of share).

**Table 16.** Achievement of U.S. (Washington) domestic catch goals for Fraser River pink salmon in 2009.

| | Actual Catch | | Share of TAC | | |
|---|---|---|---|---|---|
| **User Category** | Fish | % | Fish | % | **Deviation** |
| **Washington Total** | 2,815,600 | 100.0% | 3,463,900 | 100.0% | -648,300 |
| Treaty Indian * | 1,032,400 | 36.7% | 1,732,000 | 50.0% | -699,600 |
| All Citizen ** | 1,783,200 | 63.3% | 1,732,000 | 50.0% | 51,200 |

* Treaty Indian catch includeds commercial and ceremonial catches.

** All Citizen catch includes commercial and recreational catches.

**Table 17.** Achievement of Canadian commercial catch goals for Fraser River pink salmon in 2009.

| Gear License Area | Actual Catch | | Catch Goals | | Deviation | |
|---|---|---|---|---|---|---|
| | Fish | % | Fish | % | Fish | % |
| Purse Seine | 906,100 | 99.0% | 640,900 | 70.0% | 265,200 | 29.0% |
| B Southern | 906,100 | 99.0% | 640,900 | 70.0% | 265,200 | 29.0% |
| Gillnet | 500 | 0.1% | 96,100 | 10.5% | -95,600 | -10.4% |
| D Johnstone Strait | 500 | 0.1% | 36,600 | 4.0% | -36,100 | -3.9% |
| E Fraser River | 0 | 0.0% | 59,500 | 6.5% | -59,500 | -6.5% |
| Troll | 9,000 | 1.0% | 178,500 | 19.5% | -169,500 | -18.5% |
| G Southern | 10 | 0.0% | 59,500 | 6.5% | -59,500 | -6.5% |
| H Inside | 8,990 | 1.0% | 119,000 | 13.0% | -110,000 | -12.0% |
| Total | 915,600 | 100.0% | 915,600 | 100.0% | | |

### D. Conservation of Other Stocks and Species

With the exception of non-Fraser pink salmon, catches of non-target stocks and species in Panel Area fisheries directed at Fraser River sockeye and pink salmon were small in 2009, largely due to the lack of sockeye-directed commercial fisheries (Table 18). By-catches of non-Fraser salmon in commercial net fisheries regulated by the Fraser River Panel totalled zero sockeye and 962,000 pink salmon, with about 65% of these pink salmon from Washington stocks and 35% from Canadian south-coast stocks. Catches of other Fraser and non-Fraser salmon species included approximately 980 chinook, 4,900 coho, 80 chum salmon and zero steelhead.

**Table 18.** Catches of non-Fraser sockeye and pink salmon and catches of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2009.

| Area and Gear | Non-Fraser | | Fraser and Non-Fraser | | | |
|---|---|---|---|---|---|---|
| | Sockeye | Pink | Chinook | Coho | Chum | Steelhead |
| United States * | 0 | 949,210 | 976 | 4,940 | 73 | 0 |
| Areas 4B, 5 and 6C Net | 0 | 56 | 3 | 185 | 4 | 0 |
| Areas 6, 7 and 7A Net | 0 | 949,150 | 973 | 4,760 | 69 | 0 |
| Canada ** | 0 | 13,230 | 0 | 0 | 8 | 0 |
| Area 20 Net | 0 | 0 | 0 | 0 | 0 | 0 |
| Area 29 Net | 0 | 13,230 | 0 | 0 | 8 | 0 |
| Total | 0 | 962,430 | 976 | 4,940 | 81 | 0 |

* Estimates for All Citizen fisheries are from the WDFW "LIFT" database.
Estimates for Treaty Indian fisheries are from the "TOCAS" database.

** Estimates are from DFO in-season hail program.

## VII. ALLOCATION STATUS

As a result of a catch overage, the U.S. owes a payback of 4,300 Fraser sockeye to Canada in future years (Table 19). There are no paybacks due for Fraser pink salmon.

**Table 19.** Allocation status for Fraser River sockeye and pink salmon in 2005-2009. After 2009, the U.S. owed a payback of 4,300 sockeye salmon. No payback was due for pink salmon.

| | Fraser Sockeye | | | | |
|---|---|---|---|---|---|
| | 2005 | 2006 | 2007 | 2008 | 2009 |
| **TOTAL ALLOWABLE CATCH** | | | | | |
| Total Run Size | 8,770,000 | 8,715,000 | 1,428,000 | 1,715,000 | 1,370,000 |
| Escapement and other deductions | 6,124,000 | 6,457,000 | 1,428,000 | 1,369,700 | 1,370,000 |
| Total Allowable Catch: | 2,646,000 | 2,258,000 | 0 | 345,300 | 0 |
| **UNITED STATES** | | | | | |
| Washington Catch | 201,000 | 708,000 | 3,400 | 49,400 | 4,300 |
| Washington Share (excids payback) * | 437,000 | 373,000 | 0 | 57,000 | 0 |
| Deviation: | -236,000 | 335,000 | 3,400 | -7,600 | 4,300 |
| Cumulative Allocation Status: | 0 ** | 0 ** | 3,400 | 0 ** | 4,300 |
| **CANADA** | | | | | |
| Catch | 1,143,000 | 4,565,000 | 197,000 | 481,100 | 73,800 |
| Share + Aboriginal Exemption | 2,609,000 | 2,285,000 | 197,000 | 688,300 | 146,800 |
| Deviation: | -1,466,000 | 2,280,000 | 0 | -207,200 | -73,000 |

| | Fraser Pink | | |
|---|---|---|---|
| | 2005 | 2007 | 2009 |
| **TOTAL ALLOWABLE CATCH** | | | |
| Total Run Size | 10,000,000 | 11,000,000 | 19,500,000 |
| Escapement and other deductions | 6,010,000 | 6,000,000 | 6,021,800 |
| Total Allowable Catch: | 3,990,000 | 5,000,000 | 13,478,200 |
| **UNITED STATES** | | | |
| Washington Catch | 338,000 | 395,100 | 2,815,600 |
| Washington Share * | 1,025,000 | 1,285,000 | 3,463,900 |
| Deviation: | -687,000 | -889,900 | -648,300 |
| Cumulative Allocation Status: | 0 ** | 0 ** | 0 ** |
| **CANADA** | | | |
| Catch | 637,000 | 406,100 | 1,714,500 |
| Share | 2,965,000 | 3,715,000 | 10,014,300 |
| Deviation: | -2,328,000 | -3,308,900 | -8,299,800 |

* Washington share of the TAC according to Annex IV of the Pacific Salmon Treaty:

1999: Shall not exceed 22.4% for Fraser sockeye and 25.7% for Fraser pinks.

2000: Shall not exceed 20.4% for Fraser sockeye.

2001: Washington share equals Washington catch for Fraser sockeye and pink salmon, by agreement between the Parties on June 12, 2002.

2002: By a Feb. 12-13, 2003 Panel agreement, the Washington share equals the Washington catch plus the maximum payback (449,000 + 47,000 = 496,000). By agreement, no paybacks generated for 2003.

2003: Shall not exceed 16.5% for Fraser sockeye minus the payback, and 25.7% for Fraser pinks plus the payback. By agreement, no paybacks generated for 2004.

2004: Shall not exceed 16.5% for Fraser sockeye. By agreement, no paybacks generated for 2005.

2005: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. Panel interpretation of Feb. 18, 2005 Commission Guidance, item 1c(ii), was that no paybacks resulted from catch overages or underages in 2005 and so no paybacks generated for 2006.

2006: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. By agreement (Feb. 14, 2008), no paybacks generated for 2007.

2007: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. The U.S. catch of 3,400 Fraser sockeye were by-catch in pink-salmon directed fisheries and were landed as ceremonial catch.

2008: Shall not exceed 16.5% for Fraser sockeye. By Panel agreement (Sep. 25, 2008), no paybacks resulted from the 2008 season.

2009: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks.

** By Panel agreement, no paybacks are to be carried forward.

# VIII. APPENDICES

## APPENDIX A: GLOSSARY OF TERMS AND ABBREVIATIONS

**Bayesian inference**: Statistical inference which allows pre-season forecasts of run size, diversion rate, and migration timing to be updated with in-season observations. Uncertainty in the estimates decreases as more in-season data become available. The name "Bayesian" comes from the frequent use of Bayes' theorem in the inference process.

**Demonstration (Demo) fishery**: Commercial Fraser River First Nations fishery in the BC Interior area.

**Difference between estimates (DBE)**: Difference between estimates of potential spawning escapement (PSE) and spawning escapement. Sources for DBEs include en route mortality and errors (bias and imprecision) introduced through the estimates of Mission escapement, spawning ground escapement, First Nations and recreational catches above Mission and stock composition. Historical DBE values are used to generate Management Adjustment (MA) models, which use estimates of migration timing and river conditions to predict the DBEs likely to be observed in the current year. DBEs may be represented as a number of fish or a percentage of the potential spawning escapement, and are related to pMAs through the formula: pDBE = (1/(1+pMA))-1. The proportional DBE is usually shown as a percentage, such that %DBE = 100 * pDBE.

**Diversion rate**: Proportion of the salmon run that migrates through Johnstone Strait (northern approach) as opposed to Juan de Fuca Strait (southern approach). Estimates may be in time steps of a week or a few days, or a value for the entire migration.

**Economic Opportunity (EO) fishery**: Commercial Fraser River First Nations fishery in the Lower Fraser area.

**ESSR**: Terminal harvest of Weaver Creek sockeye that are "Excess Salmon to Spawning Requirements".

**Fishery Simulation Model**: A pre-season model that allows the Panel to evaluate the impacts of various fishery options on the achievement of management objectives, given such pre-season expectations as abundance, stock composition, migration timing, diversion rate, spawning escapement targets, management adjustments and catch objectives.

**Food, Social and Ceremonial (FSC) fishery**: Non-commercial First Nations fishery.

**Gross Escapement**: Total migration of sockeye or pink salmon into the Fraser River, excluding any commercial catch in the river.

> **In-season gross escapement**: Sum of the escapement past Mission plus First Nations, recreational and ESSR catches in the Fraser River below Mission.
>
> **Post-season gross escapement**: Sum of spawning ground enumerations, Run-size Adjustments (RSAs), and catches in First Nations (FSC and EO/Demo), recreational and ESSR fisheries in the Fraser watershed.

**Management Adjustment (MA)**: Additional fish added to an escapement target for the purpose of increasing the likelihood of achieving the escapement target. Such MAs are calculated using MA models, which use estimates of migration timing and river conditions to predict proportional adjustments (pMA) to spawning escapement targets. The pMAs are multiplied by the spawning escapement targets to calculate numerical MAs. MAs are calculated pre-season as inputs for pre-season planning, and at regular intervals during the fishing season based on in-season estimates of migration timing, and observed and forecasted river conditions. DBEs are related to pMAs through the formula: pMA = ((1/(1+pDBE))-1, where pDBE is the %DBE represented as a proportion.

**Management group or Run-timing group**: Aggregates of sockeye salmon stocks that are used in Fraser Panel management, i.e., Early Stuart, Early Summer, Summer, Birkenhead and Late-run groups.

**Migration date or 50% date**: Date when half (50%) of the total run would have passed a certain geographical location, if all the fish in the run are assumed to have migrated via that route.

> **Area 20 date**: An index of marine migration timing, assuming the entire run migrated through Canadian fishery management Area 20 in Juan de Fuca Strait.
>
> **Mission date**: An index of in-river migration timing, as estimated by the date when 50% of the total Mission escapement (usually identified by individual stock or stock group) is estimated to have passed Mission.
>
> **Reconstructed Mission date**: An index of in-river migration timing based on the reconstructed run to Mission (Mission escapements plus catches seaward of Mission). Reconstructed Mission dates are generally not available in-season for Late-run stocks for which a portion of the run is expected to delay prior to entering the Fraser River.

**Mission Escapement or Mission Passage**: PSC estimates of the daily number of fish that migrate upstream past the hydroacoustic field station at Mission, B.C. Mission passage is primarily estimated by hydroacoustic methods, but at times (early and late in the season) is supplemented by expanded CPUE estimates derived from in-river test fisheries.

**Potential Spawning Escapement (PSE)**

> **Potential spawning escapement target**: In-season target for PSE by management group, where the PSE target is the sum of the spawning escapement target plus the management adjustment (MA). May also be called the "Adjusted Spawning Escapement target". The management objective is to achieve the PSE target in-season as measured by the potential spawning escapement.
>
> **Potential spawning escapement**: Mission escapement estimate minus First Nations and recreational catches above Mission. If there were no en route mortalities or estimation errors in Mission escapement, up-river catches, spawning escapement or stock identification, the potential spawning escapement would in theory equal the enumerated spawning populations.

**Run size**: Total abundance or total return of a stock, management group or entire population of Fraser River sockeye or pink salmon.

**Run-size Adjustment**: Additions to the total return in cases when there is evidence that more fish returned than were accounted for in catch and escapement, e.g., evidence of en route mortality, spawning grounds that did not have enumeration programs.

**Spawning Escapement**

> **Spawning escapement or Net escapement**: Spawning escapement of adult male and female spawners and jack spawners (precocious age 3 males) as estimated through enumeration programs conducted on the spawning grounds, or projected from other data when such programs are not conducted in all areas (e.g., Quesnel spawners in 2002). Such escapement numbers do not include losses from pre-spawn mortality on the spawning grounds, however, pre-spawn mortality is accounted for in estimates of Effective Female spawners.
>
> **Spawning escapement target**: Target for total adult spawning escapement for each spawning population as defined each year by Canada's Spawning Escapement Plan.

**Total Allowable Mortality rule (TAM rule):** For each Fraser sockeye management group at different run sizes, Canada's Spawning Escapement Plan specifies the total allowable mortality from all sources, including fishery removals (catch) and en route mortality (represented by the Management Adjustment).

**List of abbreviations**

| | |
|---|---|
| ADFG: Alaska Department of Fish and Game | JS: Johnstone Strait |
| AFE: Aboriginal Fishery Exemption | LGL: A biological consulting company |
| BC: Province of British Columbia | MA: Management Adjustment |
| DBE: Difference between estimates | MLP: Mandatory Landing Program |
| CPUE: Catch per Unit of Effort | M-R: Mark-recapture |
| DFO: Fisheries and Oceans Canada | pMA: Proportional Management Adjustment |
| DIDSON: Dual-frequency IDentification SONar | PSC: Pacific Salmon Commission |
| EO: Economic Opportunity | PSE: Potential spawning escapement |
| ESSR: Excess Salmon to Spawning Requirements | RSA: Run Size Adjustment |
| FRP: Fraser River Panel | SE: Spawning Escapement |
| FRPTC: Fraser River Panel Technical Committee | SET: Spawning Escapement Target |
| FSC: "Food, social and ceremonial" | TAC: Total Allowable Catch |
| GSI: Genetic Stock Identification | TAM: Total Allowable Mortality |
| | WDFW: Washington Department of Fish and Wildlife |

## APPENDIX B: 2009 PRE-SEASON FORECASTS AND SPAWNING ESCAPEMENT TARGETS FOR FRASER RIVER SOCKEYE AND PINK SALMON

**Table 1**. Pre-season forecasts for Fraser River sockeye and pink salmon in 2009. (Provided to the Panel by Fisheries and Oceans Canada)

| | | | | | Probability of Achieving Specified Run Sizes [a] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sockeye stock/timing group | CUs (Table 2) | Forecast Model [b] | Mean Run Size [c] all cycles | Mean Run Size [c] 2009 cycle | 0.1 | 0.25 | 0.5 | 0.75 | 0.9 |
| **Early Stuart** [d] | 1,2 | Pooled | **335,000** | **797,000** | **645,000** | **426,000** | **255,000** | **165,000** | **107,000** |
| **Early Summer** | | | - | - | **2,284,000** | **1,338,000** | **739,000** | **443,000** | **264,000** |
| *(total excuding miscellaneous)* | | | *(501,000)* | *(316,000)* | *(1,234,000)* | *(749,000)* | *(443,000)* | *(272,000)* | *(177,000)* |
| Bowron | 3 | Ricker (eff)-pi | 23,000 | 13,000 | 25,000 | 16,000 | 10,000 | 6,000 | 4,000 |
| Fennell | 4 | Ricker (eff) | 28,000 | 17,000 | 101,000 | 60,000 | 34,000 | 21,000 | 12,000 |
| Gates | 5 | Ricker (eff)-cyc | 65,000 | 52,000 | 224,000 | 127,000 | 74,000 | 44,000 | 30,000 |
| Nadina | 6,7 | Ricker (eff)-peak | 81,000 | 78,000 | 181,000 | 118,000 | 73,000 | 43,000 | 28,000 |
| Pitt | 8 | Power (eff) | 61,000 | 79,000 | 270,000 | 189,000 | 124,000 | 86,000 | 58,000 |
| Raft | 4 | Power (eff) | 32,000 | 31,000 | 209,000 | 131,000 | 78,000 | 49,000 | 32,000 |
| Scotch | 9 | RS1 (naive) | 64,000 | 20,000 | 170,000 | 77,000 | 32,000 | 13,000 | 6,000 |
| Seymour | 9 | Ricker (eff)-cyc | 147,000 | 26,000 | 54,000 | 31,000 | 18,000 | 10,000 | 7,000 |
| Misc [e] | 9 | R/S | - | - | 22,000 | 12,000 | 6,000 | 4,000 | 2,000 |
| Misc [f] | 4,10 | R/S | - | - | 47,000 | 27,000 | 13,000 | 8,000 | 4,000 |
| Misc [g] | 11 | R/S | | | 25,000 | 14,000 | 7,000 | 4,000 | 2,000 |
| Misc [h] | 12 | R/S | - | - | 156,000 | 88,000 | 44,000 | 25,000 | 13,000 |
| Misc [i] | 4 | R/S | | | 800,000 | 448,000 | 226,000 | 130,000 | 66,000 |
| **Summer** | | | **5,677,000** | **11,111,000** | **31,813,000** | **16,071,000** | **8,677,000** | **4,914,000** | **2,858,000** |
| Chilko | 13,14 | Power (smolt) | 1,760,000 | 1,396,000 | 9,466,000 | 6,136,000 | 4,175,000 | 2,870,000 | 1,857,000 |
| Late Stuart | 15,16 | R1C (naive) | 834,000 | 2,300,000 | 3,538,000 | 1,469,000 | 553,000 | 208,000 | 86,000 |
| Quesnel [j] | 17,18,19 | Pooled | 2,556,000 | 7,082,000 | 18,037,000 | 7,936,000 | 3,575,000 | 1,575,000 | 724,000 |
| Stellako | 19,20,21 | Larkin (eff) | 527,000 | 333,000 | 772,000 | 530,000 | 374,000 | 261,000 | 191,000 |
| **Late** | | | - | - | **2,875,000** | **1,616,000** | **907,000** | **517,000** | **327,000** |
| *(total excuding miscellaneous)* | | | *(3,242,000)* | *(946,000)* | *(2,665,000)* | *(1,482,000)* | *(843,000)* | *(485,000)* | *(310,000)* |
| Cultus | 22 | Power (Smolt)-Jack | 19,000 | 3,000 | 16,000 | 10,000 | 5,000 | 3,000 | 1,000 |
| Harrison | 23 | Ricker (eff)-PDO | 47,000 | NA | 373,000 | 160,000 | 69,000 | 46,000 | 33,000 |
| Late Shuswap | 24 | Ricker (eff)-cyc | 2,204,000 | 78,000 | 407,000 | 171,000 | 70,000 | 26,000 | 10,000 |
| Portage | 25 | Ricker (eff) | 58,000 | 74,000 | 259,000 | 140,000 | 66,000 | 31,000 | 16,000 |
| Weaver | 26 | Larkin (eff) | 432,000 | 332,000 | 906,000 | 546,000 | 336,000 | 200,000 | 126,000 |
| Birkenhead | 27 | Power (eff) | 482,000 | 459,000 | 704,000 | 455,000 | 297,000 | 179,000 | 124,000 |
| Misc. Shuswap [k] | 24,28,29 | R/S | - | - | 91,000 | 56,000 | 27,000 | 17,000 | 11,000 |
| Misc. non-Shuswap [k] | 30,31 | R/S | - | - | 119,000 | 78,000 | 37,000 | 15,000 | 6,000 |
| **TOTAL** | | | - | - | **37,617,000** | **19,451,000** | **10,578,000** | **6,039,000** | **3,556,000** |
| *(TOTAL excluding miscellaneous)* | | | *(9,755,000)* | *(13,170,000)* | *(36,357,000)* | *(18,728,000)* | *(10,218,000)* | *(5,836,000)* | *(3,452,000)* |
| **Pink Salmon** | 32 | | ***12,067,000*** | - | **32,939,000** | **24,858,000** | **17,535,000** | **12,490,000** | **9,343,000** |

a. probability that the actual run size will exceed the specified projection.
b. see Cass et al. (2006) and DFO (2007) for model descriptions.
c. sockeye: 1980-2005 (excluding miscellaneous stocks); pink: 1961-2005.
d. Early Stuart is pooled power and RS2 model (average weighted from retro analysis)
e. unforecasted misc. Early Summer stocks (Early Shuswap stocks: S.Thompson); return timing most similar to Scotch/Seymour).
f. unforecasted misc. Early Summer stocks (N. Thomson tributaries; return timing most similar to Fennell/Bowron/Nadina).
g. Nahatlach River & Lake
h. Chilliwack Lake and Dolly Varden Creek; return timing most similar to Early Stuart.
i. North Thompson River.
j. Quesnel is a pooled Larkin and Power model (average weighted from retro analysis performance during dominant yr)
k. unforecasted miscellaneous Late Run stocks; true lates made up a very small component (~800 at 50% prob. level)

Model definitions: pi (Pine Island SST covariate); cyc (cycle line data only); peak (Fraser R. peak discharge covariate); PDO (Pacific Decadal Oscillation (PDO) covariate); RS1 (product of R/S from last generation & eff fem spawners in brood year); RS2 (product of R/S from last 2 generations and eff fem spawners in brood year); R1C (rec from last generation); R/S (used for stocks with no recruit data: product of R/S for run timing group and eff fem spawners).

**Table 2**. Fraser River sockeye and pink salmon spawning escapement plan (in thousands of fish) for 2009. (Provided to the Panel by Fisheries and Oceans Canada)

| Stock Group | Forecast Return (*a*) | Run Size Reference Points | Total Mortality Rate Guidelines | Total Allowable Mortality at Run Size | Escapement Target at Run Size |
|---|---|---|---|---|---|
| **Early Stuart** | | 0 - 156 | 0% | | |
| *a* | 165 | 156 - 390 | 0 - 60% | 5% | 156 |
| | | >390 | 60% | | |
| **Early Summer** | | 0 - 200 | 0% | | |
| | | 200 - 500 | 0 - 60% | | |
| | 739 | >500 | 60% | 60% | 296 |
| **Summer** | | 0 - 520 | 0% | | |
| | | 520 - 1,300 | 0 - 60% | | |
| | 8,677 | >1,300 | 60% | 60% | 3,471 |
| **Birkenhead** | | | 0% | | |
| | 334 | | 0 - 60% | 60% | 134 |
| | | | 60% | | |
| **Late** | | 0 - 420 | 20% | | |
| | 573 | 420 - 1,049 | 20 - 60% | 27% | 420 |
| | | >1,049 | 60% | | |
| **Totals** | 10,488 | | | | 4,477 |
| **Pink** | | 0 - 7,059 | 0 - 15% | | |
| | | 7,059 - 17,143 | 15 - 65% | | |
| | 17,535 | >17,143 | 65 - 70% | 66% | 6,000 |

a The 75p forecast level was used for Early Stuart, and the 50p forecast level for the other Fraser management groups.

## APPENDIX C: 2009 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS (agreed June 18, 2009)

1. Fisheries and Oceans Canada (DFO) have provided the Panel with run-size forecasts for Fraser River sockeye and pink salmon. There is a 50% probability that the Fraser sockeye salmon return will reach or exceed 10,578,000 fish. There is a 50% probability the Fraser pink salmon return will reach or exceed 17,535,000 fish. For pre-season planning purposes, the Panel used the 50% probability (p) levels of abundance for each species with the exception of Early Stuart sockeye for which the 75% probability level of abundance (165,000 fish) was used. The resulting total sockeye return used for pre-season planning was 10,488,000 fish.
2. The Panel's first priority for 2009 is to achieve conservation objectives for all stocks, including Late-run sockeye[13] objectives as indicated in the document, "Guidelines for Pre-season Fraser Sockeye Fishing Plans to Address Late-Run Concerns".
3. The Panel has adopted a management approach for Late-run sockeye that presumes that similar to recent years, Late-run sockeye will enter the Fraser River early and a significant proportion will not survive to spawn.
4. TAC and international shares will be calculated according to the February 15, 2008 Commission Guidance and the 2005 revised Annex IV, Chapter 4, of the Pacific Salmon Treaty, which limits the United States harvest (in Washington State) to 16.5% of the total allowable catch (TAC) of Fraser River sockeye salmon. Based upon the pre-season levels of abundance used for the purposes of computing TAC by stock management grouping in 2009, the Panel agreed that the Fraser River Aboriginal Exemptions were as follows: Early Stuart sockeye, 10,000 fish, Early Summer sockeye, 30,600 fish; Summer-run sockeye, 342,600 fish; Birkenhead sockeye, 5,800 fish; and Late-run sockeye, 11,000 fish. There is no available harvest of Early Stuart sockeye at the 75% p level forecast of abundance. However, management plans including window closures are designed to protect 90% of the Early Stuart migration. With respect to Fraser River pink salmon, under the terms of Annex IV, Chapter 4, of the Pacific Salmon Treaty, the United States share of the TAC is 25.7%, while the Canadian share is 74.3%. As per Fraser Panel agreement, there are no catch overages of Fraser River sockeye or pink salmon for the 2009 season resulting from prior years.
5. For planning fisheries, the Panel has adopted 75% probability level forecast for Early Stuart (165,000 fish), and the 50% probability level forecasts for Early Summer-run (739,000 fish), Summer-run (8,677,000 fish), Birkenhead[14] (334,000),Late-run sockeye (573,000) and for Fraser River pink salmon (17,535,000 fish). When sufficient information is available in-season, the Panel will update run size estimates of Fraser River sockeye and pink salmon, as appropriate.

**Regulations**

i) If the abundance of Early Summer-run sockeye salmon is tracking at approximately the 50% probability level (739,000 fish) and the abundance of Summer-run sockeye salmon is tracking at approximately the 50% probability level (8,677,000 fish) and the runs arrive at or near normal dates, low impact fisheries in Panel Waters would be expected to commence the week of July 19 - 25. If the return abundances of Early Summer-run and Summer-run sockeye vary from the 50% probability level forecast, this could change the start dates, and duration of fisheries.

ii) Fisheries directed at Fraser River pink salmon will be managed in accordance with the Late-run sockeye guidelines.

iii) The Parties' conservation concerns for other species and stocks will be taken into account throughout the 2009 management season.

[13] Late-run here refers to the Late-run timing group, excluding Birkenhead and a few minor miscellaneous sockeye stocks.

[14] Birkenhead includes Big Silver and other miscellaneous stocks.

## APPENDIX D: GUIDELINES FOR PRE-SEASON FRASER SOCKEYE FISHING PLANS TO ADDRESS LATE-RUN [15] CONCERNS (agreed June 18, 2009)

The 2009 cycle is the second off-line cycle for Adams River sockeye, and "true" Late-run sockeye have historically experienced small returns on this cycle line relative to Summer-run sockeye, with the Weaver Creek stock group the predominant Late-run stock. Due to the extremely late arrival of all sockeye stocks in 2005, most Late-run stocks were less severely impacted by early upstream migration in the brood year (2005) relative to recent years. In addition, there was an unexpectedly large return of Harrison sockeye in 2005. As a consequence, the total forecast for Late-run sockeye in 2009 (573,000 fish at the 50% p level) is approximately 23% larger than the average for the cycle (1980 – 2005). However, the potential continuation of high in-river mortality rate experienced by several Late-run stocks in recent years continues to be a serious conservation concern and there is a special concern for critically depressed Cultus sockeye for which recovery efforts have been implemented by Canada to ensure this stock's long-term viability. A co-ordinated approach to management will be developed that reflects both Parties sharing the burden of conservation for Late-run sockeye.

### ASSUMPTIONS AND ELEMENTS OF THE PLAN

1. For fisheries planning purposes, we applied a precautionary approach and assumed that Late-run sockeye will continue their post-1995 early upstream migration behaviour. Given pre-season assumptions about marine timing and recent delay behaviour, the median upstream migration date for Late-run sockeye in 2009 is expected to occur during the 3rd week of August. Given this timing and based on the 50p forecast level of abundance (573,000 fish), the exploitation rate limit is 20%.

2. The pre-season fishing plan assumes a 6 day separation in the 50% marine migration timing date (through Juan de Fuca Strait; Area 20) between Summer-run (August 5) and Late-run sockeye (August 11).

3. Estimates of abundance, migration timing, etc., for Summer-run and Late-run sockeye will be provided in-season and PSC staff will advise the Panel if changes to pre-season assumptions are warranted. However, for Late-run sockeye, upstream timing would have to be substantially later (e.g. mid-September) and return abundance substantially larger (greater than 1 million) than expected for the combination of the spawning escapement plan and the agreed management adjustment to result in allowable exploitation rates greater than 20%. Furthermore, the timeliness of Late-run updates will depend on the pattern of migration and updates may not be available during the period of active in-season Panel Area management. Thus, given the above circumstances, is it unlikely that the allowable exploitation rate for Late-run sockeye would increase above 20%.

4. Staff will not be able to provide in-season stock-specific assessments for Cultus sockeye due to their very low forecast abundance (5,000 fish at the 50% p level) relative to much more abundant co-migrating stocks. Consequently, assessments of Cultus sockeye harvest impacts will rely on the use of other, more abundant Late-run stocks as indicators of their relative contribution to catches.

5. To help ensure that Late-run conservation objectives are achieved, fisheries directed at Summer-run sockeye will be constrained by limits on Late-run sockeye harvest impacts. Late-run sockeye catches will be estimated primarily with DNA stock identification methods.

[15] Late-run here refers to the Late-run timing group, excluding Birkenhead and a few minor miscellaneous sockeye stocks.

## APPENDIX E: 2009 REGULATIONS

The Fraser River Panel approved regulations for the management of the Fraser River sockeye and pink salmon fishery in Panel Area waters and submitted these to the Pacific Salmon Commission. The Commission approved the Fishery Regime and Regulations and submitted these to the respective national governments for approval on June 18, 2009.

**Canadian Fraser River Panel Area**

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends to the Canadian Government the adoption of the following Fishing Regime developed by the Fraser River Panel, namely:

1. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 with nets from the 28th day of June, 2009, to the 19th day of September, 2009, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 from the 28th day of June, 2009, to the 19th day of September, 2009, both dates inclusive.

2. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Areas 17 and 18 with nets from the 28th day of June, 2009 to the 26th day of September, 2009, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 18-1, 4 and 11 from the 28th day of June, 2009, to the 26th day of September, 2009, both dates inclusive.

3. a) No person shall commercially fish for sockeye or pink salmon with nets in Pacific Fishery Management Area 29 from the 28th day of June, 2009, to the 10th day of October, 2009, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 29 from the 28th day of June, 2009, to the 10th day of October, 2009, both dates inclusive.

4. The following Fraser River Panel Area waters are excluded:

   a) High Seas westerly of the Bonilla Point-Tatoosh Island Lighthouse Line.

   b) Pacific Fishery Management Area 19, Area 20-2 and 5 to 7 and Area 29-8.

   c) Commercial troll fishing in Pacific Fishery Management Area 17, Area 18-2, 3 and 5 to 10.

During the 2009 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2009 Management Plan adopted by the Panel. This Plan will be designed to achieve Pacific Salmon Treaty-mandated conservation objectives, international allocations of the catch, and domestic goals of the Parties.

**United States Fraser River Panel Area**

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends to the United States Government the adoption of the following Fishing Regime developed by the Fraser River Panel, namely:

Treaty Indian Fisheries:

1. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5 and 6C with drift gillnets or purse seines from the 28th day of June, 2009 to the 19th day of September, 2009, both dates inclusive.
2. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 28th day of June, 2009, to the 26th day of September, 2009, both dates inclusive.
3. No Treaty Indian shall commercially fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 27th day of September, 2009, to the 3rd day of October, 2009, both dates inclusive.

All-Citizen Fisheries:

1. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5, and 6C with nets from the 28th day of June, 2009, to the 19th day of September, 2009, both dates inclusive.
2. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 28th day of June, 2009, to the 26th day of September, 2009, both dates inclusive.
3. No person shall fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 27th day of September, 2009, to the 3rd day of October, 2009, both dates inclusive.

The following Fraser River Panel Area waters and fisheries are excluded:

Treaty Indian and All-Citizen Fisheries:

1. High Seas westerly of the Bonilla Point-Tatoosh Island Lighthouse Line.
2. Puget Sound Salmon Management and Catch Reporting Areas 6B, 6D, 7B, 7C, 7D and 7E.

During the 2009 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2009 Management Plan adopted by the Panel. This Plan will be designed to achieve Pacific Salmon Treaty-mandated conservation objectives, international allocations of the catch, and domestic goals of the Parties.

## APPENDIX F: 2009 FRASER RIVER PANEL IN-SEASON ORDERS

To provide for adequate escapement of the various stocks of Fraser River sockeye and pink salmon and for the prescribed allocation of catch: (a) internationally, between the United States and Canada and (b) domestically, among the commercial user groups in Canada and the United States, the Fraser River Panel formulated the following orders to regulate Panel Area fisheries in 2009.

August 25, 2009

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Open to drift gillnets from 12:00 p.m. (noon), Wednesday, August 26, 2009 to 12:00 p.m. (noon) Saturday, August 29, 2009.

All Citizen Fishery

Areas 7 and 7A

Open to reefnets for pink salmon with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Wednesday, August 26, 2009; 5:00 a.m. to 9:00 p.m. Thursday, August 27, 2009; and from 5:00 a.m. to 9:00 p.m. Friday, August 28, 2009.

August 26, 2009

United States

Treaty Indian Fishery

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m., Friday, August 28, 2009 to 8:00 a.m. Saturday, August 29, 2009.

All Citizen Fishery

Area 7

Open to purse seines for pink salmon with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m., Thursday, August 27, 2009.

Area 7

Open to gillnets for pink salmon with non-retention of sockeye salmon from 8:00 a.m. to 11:59 p.m. (midnight), Thursday, August 27, 2009.

Area 7A

Open to purse seines for pink salmon with non-retention of sockeye salmon from 3:00 p.m. to 9:00 p.m., Thursday, August 27, 2009.

Area 7A

Open to gillnets for pink salmon with non-retention of sockeye salmon from 3:00 p.m. to 11:59 p.m. (midnight), Thursday, August 27, 2009.

August 28, 2009

Canada

Area 18-4

Open for Area H troll ITQ fishery for pink salmon with non-retention of sockeye salmon 12:01 a.m. Sunday, August 30, 2009 until further notice.

United States

Treaty Indian Fishery

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m., Sunday, August 30, 2009 to 8:00 a.m. Monday, August 31, 2009 and from 5:00 a.m. Tuesday, September 1, 2009 to 8:00 a.m. Wednesday, September 2, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Saturday, August 29, 2009 to 12:00 p.m. (noon) Wednesday, September 2, 2009.

All Citizen Fishery

Areas 7 and 7A

Open to purse seines for pink salmon with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Saturday, August 29, 2009 and from 5:00 a.m. to 9:00 p.m. Monday, August 31, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to gillnets for pink salmon with non-retention of sockeye salmon from 8:00 a.m. to 11:59 p.m. (midnight) Saturday, August 29, 2009 and from 8:00 a.m. to 11:59 p.m. (midnight), Monday, August 31, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to reefnets for pink salmon with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Saturday, August 29, 2009; 5:00 a.m. to 9:00 p.m. Sunday, August 30, 2009; 5:00 a.m. to 9:00 p.m. Monday, August 31; and from 5:00 a.m. to 9:00 p.m. Tuesday, September 1, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

September 1, 2009

United States

Treaty Indian Fishery

Areas 6, 7, and 7A

Extended for net fishing from 8:00 a.m., Wednesday, September 2, 2009 through 11:00 a.m., Saturday, September 5, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, September 2, 2009 to 12:00 p.m. (noon) Saturday, September 5, 2009.

All Citizen Fishery

Areas 7 and 7A

Open to purse seines for pink salmon with non-retention of sockeye salmon from 10:00 a.m. to 9:00 p.m. Thursday, September 3, 2009 and from 5:00 a.m. to 9:00 p.m. Friday, September 4, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to gillnets for pink salmon with non-retention of sockeye salmon from 10:00 a.m. to 11:59 p.m. (midnight) Thursday, September 3, 2009 and from 8:00 a.m. to 11:59 p.m. (midnight), Friday, September 4, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to reefnets for pink salmon with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Wednesday, September 2, 2009; 5:00 a.m. to 9:00 p.m. Thursday, September 3, 2009; and 5:00 a.m. to 9:00 p.m. Friday, September 4, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

September 4, 2009

United States

Treaty Indian Fishery

Areas 6, 7, and 7A

Extended for net fishing from 11:00 a.m., Saturday, September 5, 2009 through 11:00 a.m., Wednesday, September 9, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Saturday, September 5, 2009 to 12:00 p.m. (noon) Wednesday, September 9, 2009.

All Citizen Fishery

Areas 7 and 7A

Open to purse seines for pink salmon with non-retention of sockeye salmon from 10:00 a.m. to 9:00 p.m. Monday, September 7, 2009 and from 5:00 a.m. to 9:00 p.m. Tuesday, September 8, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to gillnets for pink salmon with non-retention of sockeye salmon from 10:00 a.m. to 11:59 p.m. (midnight) Monday, September 7, 2009 and from 8:00 a.m. to 11:59 p.m. (midnight), Tuesday, September 8, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to reefnets for pink salmon with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Saturday, September 5, 2009; 5:00 a.m. to 9:00 p.m. Sunday, September 6, 2009; 5:00 a.m. to 9:00 p.m. Monday, September 7, 2009; and from 5:00 a.m. to 9:00 p.m. Tuesday, September 8, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

September 8, 2009

United States

Treaty Indian Fishery

Areas 6, 7, and 7A

Extended for net fishing from 11:00 a.m., Wednesday, September 9, 2009 through 11:00 a.m., Saturday, September 12, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, September 9, 2009 to 12:00 p.m. (noon) Saturday, September 12, 2009.

All Citizen Fishery

Areas 7 and 7A

Open to purse seines for pink salmon with non-retention of sockeye salmon from 10:00 a.m. to 9:00 p.m. Thursday, September 10, 2009 and from 5:00 a.m. to 9:00 p.m. Friday, September 11, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia

Areas 7 and 7A

Open to gillnets for pink salmon with non-retention of sockeye salmon from 10:00 a.m. to 11:59 p.m. (midnight) Thursday, September 10, 2009 and from 8:00 a.m. to 11:59 p.m. (midnight), Friday, September 11, 2009 southerly and

easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to reefnets for pink salmon with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Wednesday, September 9, 2009; 5:00 a.m. to 9:00 p.m. Thursday September 10, 2009; and from 5:00 a.m. to 9:00 p.m. Friday, September 11, 2009 southerly and easterly of a straight line drawn from the Iwersen's Dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

September 10, 2009

United States

All Citizen Fishery

Areas 7 and 7A

The previously announced purse seine fishery for pink salmon that was to occur from 5:00 a.m. to 9:00 p.m. Friday, September 11, 2009, has been cancelled.

Areas 7 and 7A

The previously announced gillnet fishery for pink salmon that was to occur from 8:00 a.m. to 11:59 p.m. (midnight), Friday, September 11, 2009 has been cancelled.

Areas 7 and 7A

The previously announced reefnet fishery for pink salmon that was to occur from 5:00 a.m. to 9:00 p.m. Friday, September 11, 2009 has been cancelled.

September 11, 2009

Canada

Area 18-4

Closes to Area H troll ITQ fishery for pink salmon with non-retention of sockeye salmon at 8:00 p.m., Friday, September 11, 2009.

Area 18-1, 18-4, and 18-11 and Area 29-1 to 6

Open to Area H troll ITQ fishery for pink salmon with non-retention of sockeye salmon from 12:01 a.m. Saturday, September 12, 2009 to 11:59 p.m., Friday, September 18, 2009. Fishery may close earlier, subject to by-catch concerns.

Area 29-3, 29-4, 29-6

Open to Area B purse seine ITQ fishery in waters deeper than 50 meters from 6:00 a.m. to 8:00 p.m. daily on Sunday, September 13, 2009, Monday, September 14, 2009, Tuesday, September 15 2009, and Wednesday, September 16, 2009. Fishery may close earlier, subject to by-catch concerns.

United States

Areas 4B, 5, and 6C

Relinquish regulatory control effective 12:01 a.m., Tuesday, September 15, 2009.

Treaty Indian Fishery

Areas 6,7, and 7A

Iwersen's Dock line boundary rescinded effective immediately (11:20 a.m., Friday, September 11, 2009).

Areas 6, 7, and 7A

Extended for net fishing from 11:00 a.m., Saturday, September 12, 2009 to 9:00 p.m. Monday, September 14.

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Saturday, September 12, 2009 to 11:59 p.m. (midnight), Monday, September 14, 2009.

September 12, 2009

United States

Areas 6, 7, and 7A

The previously announced net fishery that was scheduled to close at 9:00 p.m. Monday, September 14, 2009 will now close at 9:00 p.m., Sunday, September 13, 2009.

September 15, 2009

Canada

Area 29-3, 29-4, 29-6

Extended for Area B purse seine ITQ fishery in waters deeper than 50 meters from 6:00 a.m. to 8:00 p.m. daily on Thursday, September 17, 2009, Friday, September 18, 2009 and Saturday, September 19, 2009.

September 17, 2009

United States

Areas 6 and 7

Relinquish regulatory control effective 12:01 a.m., Friday, September 18, 2009.

Fraser River Panel control of Canadian Panel Areas was relinquished in accordance with the pre-season Regulations (Appendix E) as follows: Area 20 on September 19; Areas 17 and 18 on September 26; and Area 29 on October 10. Panel control of United States Panel Areas were relinquished as follows; Areas 4B, 5 and 6C on September 15 by in-season order; Areas 6 and 7 on September 18 by in-season order; and Area 7A on October 3 in accordance with the pre-season Regulations.

## APPENDIX G: PSC STOCK MONITORING, IDENTIFICATION AND ASSESSMENT PROGRAMS

### Stock Monitoring

Stock monitoring programs assess the abundance and migration timing of Fraser River sockeye and pink salmon at different points along their migration route. In conjunction with stock composition information from the Stock Identification Group, the Stock Monitoring Group uses test fishery data from marine and freshwater areas, hydroacoustic abundance estimates collected in the Fraser River at Mission, B.C., and visual observations at Hells Gate. In addition to providing estimates of daily and cumulative passage in marine areas and at Mission, stock monitoring analyses provide projections of the number of fish migrating between marine areas and Mission, and estimates of diversion rates through Johnstone Strait. This information is required for the development of fishing plans that aid in meeting spawning escapement and catch allocation objectives.

### A. Test Fishing

Test fisheries provide much of the data used to assess the migrations of Fraser sockeye and pink salmon, including abundance-related data such as catch-per-unit-effort (CPUE) and biological samples from which stock composition estimates are obtained. While Table 4 in the main body of the report summarizes the locations and temporal patterns of Panel-approved test fisheries, Table 1 below summarizes more detailed information about the nets and sampling strategies employed.

**Table 1.** Sampling details for Panel-approved test fisheries conducted in 2009.

| Area | Name | Gear | Number of Vessels | Net Length (m) | Net Depth (meshes) | Mesh Size (mm) | Mesh Size (in) | Number of Sets | Set Duration (minutes) |
|---|---|---|---|---|---|---|---|---|---|
| **Canadian Panel Areas** | | | | | | | | | |
| 20 | Juan de Fuca Str. | Gillnet | 2 | 547 | 90 | 130 | 5 1/8 | 2 | 300 |
| 20 | Juan de Fuca Str. | Purse Seine | 1 | 547 | 875 | 95 | 3 3/4 | 6 | 20 |
| 29-1 to 6 | Str. of Georgia | Troll | 1 | n/a | n/a | n/a | | n/a | n/a |
| 29-14 | Fraser R. (Cottonwood) | Gillnet | 1 | 292 | Variable | Variable | | 2 | 30 |
| 29-16 | Fraser R. (Whonnock) | Gillnet | 1 | 319 | Variable | Variable | | 2 | 20 |
| 29-16 | Fraser R. (Mission) | Gillnet | 1 | 30 | 30 | 133 | 5 1/4 | 1-3 | Variable |
| **United States Panel Areas** | | | | | | | | | |
| 5 | Juan de Fuca Str. | Gillnet | 1 | 803 | 220 | 130 | 5 1/8 | 2 | 400 |
| 7 | San Juan Islands | Reefnet [1] | 3 | n/a | n/a | n/a | | n/a | n/a |
| **Canadian Non-Panel Areas** | | | | | | | | | |
| 12 | Queen Charlotte Str. (Round Is.) | Gillnet [2] | 1-2 | 365 | 60-90 | 95 | 3 3/4 | 4 | 100 |
| 12 | Johnstone Str. (Naka Cr.) | Gillnet [2] | 1 | 365 | 90 | 130 | 5 1/8 | 4 | 100 |
| 12 | Johnstone Str. (Blinkhorn) | Purse Seine | 1-2 | 401 | 575 | 95 | 3 3/4 | 6 | 20 |
| 13 | Lower Johnstone Str. | Purse Seine | 1-2 | 401 | 575 | 95 | 3 3/4 | 6 | 20 |

*1* Reefnet observations are made during periods of favorable tides. Fish are counted as they swim through the gear, but are not harvested.

*2* Round Island Vessels used a 60 mesh nylon net and Naka Creek Vessels used a 90 Mesh Alaska twist net.

Information about the migration of sockeye and pink salmon through marine areas is provided primarily by test fisheries in Area 20 (Juan de Fuca Strait) and Areas 12 and 13 (Johnstone Strait), but is augmented during the early part of the season by test fisheries in U.S. Areas 5 (Juan de Fuca Strait) and 7 (San Juan Islands). For Fraser River pink salmon, CPUE and stock composition data from the seine test fisheries in Areas 20 and 12 are particularly important for estimating total abundance. Test fisheries in the Fraser River (Area 29) are used to assess species and stock composition for application to Mission passage estimates. The Whonnock test fishery is designed

primarily for species composition while the Cottonwood test fishery is oriented more to sockeye stock composition. When the Mission hydroacoustic program is not active or when the presence of pink salmon confounds the estimation of hydroacoustic-based sockeye passage at Mission, Area 29 test fisheries also provide sockeye abundance estimates through the use of CPUE models.

The earliest indication of low sockeye returns in 2009 were very poor catches in the marine test fisheries. Catches in the Area 20 gillnet fishery remained low throughout June and July, with no indication of building abundance or a peak abundance. Catches in the Area 20 seine test fishery were similarly weak. While low Area 20 catches in past years have been associated with high diversion through Johnstone Strait, this was not the case in 2009. Gillnet catches in the Round Island (Area 12) test fishery remained weak throughout the season. Purse seine catches in Areas 12 and 13 were similarly low compared to past years, although small increases in abundance were observed between July 28-August 6 and August 9-18.

In the Fraser River, gillnet test fishery catches at both Cottonwood and Whonnock were very low compared to past years, and therefore did not provide strong signals about sockeye migration timing. On most days fewer than 100 sockeye were caught. Peak catches at these sites did line up with peak abundances at Mission, however. Catches at Cottonwood peaked on August 5 and August 15, and at Whonnock on August 6 and August 17-18. Corresponding peaks in sockeye abundance at Mission occurred on August 8 and August 17-18. As in recent years, seal predation at the two gillnet sites were a source of concern. The Seal Deterrence Study that was initiated in 2007 and 2008 continued in 2009 at the Cottonwood test fishery. In this study, the effectiveness of using a gillnet surrounded by an electric field to reduce the number of fish removed by seals was tested (see Section *ii*, below).

In contrast, purse seine test fishery catches of pink salmon in Juan de Fuca Strait were among the highest on record, and in Johnstone Strait were strong although not as high as in some past years. The combined abundance of Fraser pinks through the two approaches resulted in one of the largest returns on record and the largest since 2003. Pink salmon catches at Whonnock were also the largest on record, signalling the largest spawning abundance of Fraser pink salmon since 2003.

Sockeye abundance at Hells Gate, as reflected by visual counts, was the lowest since 1965. However, there were no indications of migration delays and passing sockeye were observed to be in good condition. The strong migration of pink salmon that was observed at Hells Gate was confirmed by observations at DFO's Qualark site (below).

In addition to the regular test fishery programs, Staff conducted the experimental programs described below.

*i. Mission experimental gillnet test fishery*

An experimental gillnet test fishery at Mission was operated for a second consecutive year on the pink salmon cycle line (i.e., 2007 and 2009). The purpose of the test fishery was to provide supplemental species composition information in the vicinity of the Mission hydroacoustics site during the period of declining sockeye and increasing pink salmon abundances. In 2009, we deployed an additional set net on the north bank of the Fraser River (100 ft. x 5 ¼ in. mesh size) to complement the south bank set net and channel drift gillnet (200 ft. x 5 ¼ in.) used in 2007. The test fishery was located one kilometre upstream of the Mission hydroacoustics site, and operated Monday through Friday for twelve days between August 21 and September 9.

*ii. Seal deterrence project at the Cottonwood test fishery*

Beginning in 1996 we observed an increasing trend in the number of seals observed per test fishing trip and a decreasing trend in catchability ($q$) [16,17] for both the Cottonwood and Whonnock

[16] Forrest, K.W, Cave, J.D., Michielsens, C.G.J., Haulena, M. and Smith, D.V. 2009. Evaluation of an electric gradient to deter seal predation on salmon caught in gill-net test fisheries. North American Journal of Fisheries Management 29(4): 885-894.

test fisheries. In essence, the removal of sockeye from the test fishing nets by seals was significantly impacting the data obtained from these important test fisheries, especially when sockeye abundances were low and the proportion of fish the seals removed from the net was high. With funding from the Southern Endowment Fund, in 2007 we began to investigate whether an electric gradient around a gillnet would deter seals from removing fish from the net.

The PSC Southern Endowment Fund Committee granted a one year extension to the 2008 seal deterrence project due to technical issues encountered with the prototype. The electrical pulse generator modules were re-engineered and testing of the seal deterrence system resumed at the Cottonwood gillnet test fishery in 2009. The multi-panel gillnet was divided into twelve electrical arrays, each array consisted of two parallel electrodes, with each pair of electrodes connected to a single pulse generator module (Figures 1 and 2).

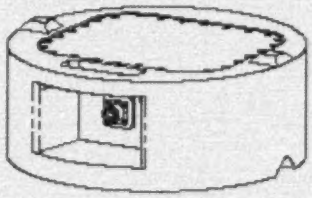

**Figure 14**. Smith-Root Inc. electrical pulse generator module. Each module measures 50 cm x 18 cm and weighs approximately 7.7 kg. LED lights, viewed through the clear top access cover, indicate module operations including off/on and battery strength.

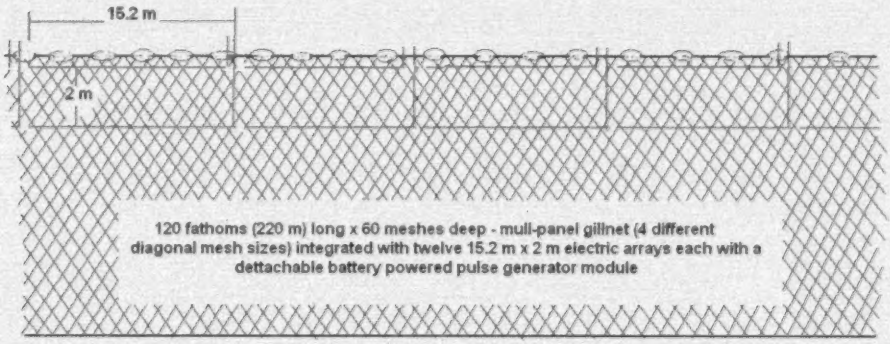
15.2 m
2 m
120 fathoms (220 m) long x 60 meshes deep - multi-panel gillnet (4 different diagonal mesh sizes) integrated with twelve 15.2 m x 2 m electric arrays each with a dettachable battery powered pulse generator module

**Figure 15**. Configuration of the Cottonwood experimental multi-panel test fishing gillnet. The net was constructed from #23-gauge multi-strand nylon. The net was 120 fathom (220 meters) long x 60 meshes deep, and divided into twelve 15.2 m long x 2 m deep electrical arrays.

The seal deterrence system was implemented at the Cottonwood test fishery between July 6 and September 18 (75 days). On average 3.2 seals were observed per fishing trip in 2009, much lower than the 6.1 and 9.5 seals observed per trip in 2008 and 2007, respectively. A similar decline in the number of seals occurred at Whonnock, however. In 2009, catchabilities at Whonnock and Cottonwood were similar, and at Cottonwood did not reach pre-1996 values, a time when fewer seals were observed per trip. We therefore cannot conclusively demonstrate that the decreased number of seals at Cottonwood in 2009 was due to the electrical deterrence system. Additional years of data will be required to assess whether electric fields can be used in the field to deter seals from removing test fishery caught salmon from nets. We successfully achieved our SEF project

[17] Forrest, K., and Smith, D. A prototype seal deterrence system for application to salmon gillnets (Fraser River Panel Cottonwood Test Fishery): Project report to the Southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. February, 2010.

goals in 2009 and will continue utilizing and collecting data from the seal deterrence system at the Cottonwood test fishery in future years.

**B. Mission Hydroacoustics**

PSC Staff have operated a hydroacoustic facility on the Fraser River near the Mission Bridge since 1977, for the purpose of providing timely in-season estimates of sockeye and pink salmon escapement through the lower river. This program has benefited from improved technologies and research in recent years[18,19]. Daily abundance at Mission is estimated using a split-beam hydroacoustic system on the south shore (i.e., "left bank") of the Fraser River, combined with a split-beam system mounted on a vessel that runs back and forth across the river. Both of these systems operate 24-hrs a day and provide information about target density, fish behaviour, vessel speed and transducer placement. Additional work focused on gathering independent diagnostic information using a DIDSON imaging sonar system to verify assumptions used in the estimation procedure.

Daily estimates of fish abundance past Mission are produced by combining estimates from shore-based and vessel-based sonar systems. The shore-based system consists of two side-looking split-beam elliptical transducers (2°×10° and 4°×10°) attached to a rotator to control the pan and tilt of the transducer units, thereby allowing sampling of the water column by the narrow sonar beams at multiple aiming angles. The aim and orientation of the transducers were monitored and verified with an attitude sensor. An extendable fish-deflection weir prevented fish from swimming in acoustic blind zones (behind or too close to the transducers), and also increased the duration for which they were insonified. This ensured adequate numbers of echoes for tracking individual fish, particularly pink salmon which typically migrate close to shore. Transducer aims were optimized to reduce unsampled areas where migratory abundance must be estimated by extrapolation. The vessel-based system consisted of a downward-looking split-beam circular transducer (15°) that transected the river every five minutes to obtain target density information.

Traces of individual fish as they passed through the sound-beam were acquired by analyzing the echo data from both shore and vessel-based systems using an alpha-beta tracker[20, 21]. The resulting trace data (i.e., "tracks") were classified as fish or noise (e.g., debris, air bubbles) using statistical methods[22] (i.e., DFA or "discriminate function analysis"). The integrity of the tracks were verified by trained staff, and unusual or atypical targets were identified and removed using graphical user interface (GUI) software. This data processing procedure was performed each day for all the data collected from both shore and vessel-based systems. The final fish track data were analyzed to produce statistics and daily summaries. Daily estimates of fish abundance were then obtained from software that used the processed shore and vessel-based data, and included calculations of sampling time, sampled area and fish passage through unsampled areas. The resulting estimates were further analyzed to obtain Mission passage by species, with the sockeye component further apportioned into stock groups. Prior to June 25 and after August 25, daily upstream passage of sockeye salmon was estimated from Whonnock (Area 29-16) test fishery CPUE data instead of Mission hydroacoustic data.

In addition to the split-beam program at Mission several other experimental programs were conducted during the 2009 season. This included a standard DIDSON unit on the south shore and

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[18] Xie, Y., A.P. Gray, F.J. Martens, and J. D. Cave. 2007. Development of a shore-based hydroacoustics system on the right bank of the Lower Fraser River to monitor salmon passages: A project report to Southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. April, 2007.

[19] Xie, Y., C.G.J. Michielsens, A.P. Gray, F.J. Martens, and J.L. Boffey. 2009. Observations of avoidance reactions of migrating salmon to a mobile survey vessel in a riverine environment. Can. J. Fish. Aquat. Sci. 65: 2178-2190.

[20] Blackman, S.S. and R. Popoli. Design and Analysis of Modern Tracking Systems. Artech House, Boston, 1999.

[21] Xie, Y., A.P. Gray, F.J. Martens, J.L. Boffey and J.D. Cave. 2005. Use of dual-frequency identification sonar to verify salmon flux and to examine fish behaviour in the Fraser River. Pacific Salmon Comm. Tech. Rep. No. 16: 58 p. Vancouver, B.C.

[22] McLachlan, G.J. (1992). Discriminant Analysis and Statistical Pattern Recognition. Wiley, New York.

a long range DIDSON on the north shore to estimate near-shore fish passage, and a mid-channel split-beam sampling experiment. Although not experimental, the traditional single-beam system that was used to produce estimates prior to 2004 was also operated. Also included in the 2009 program were new analytical techniques to deal with target recognition uncertainty during the Early Stuart migration, data exchange and estimate comparisons between Mission and DFO's Qualark hydroacoustic site, and a new method of stratifying estimates of daily salmon passage across the river using gillnet test fishery and fish-wheel catches.

*i. DIDSON insonification of near-shore fish passage*

An important application of DIDSON technology in the 2009 field season was to insonify and estimate fish passage in near-shore areas of both the south and north river banks at Mission. To achieve this purpose a standard DIDSON unit was deployed on the left-bank between July 6 - September 27 and a long range DIDSON unit was deployed on the right-bank between July 17 - September 23. Both systems collected continuous daily fish passage data up to 20 m off both shores using systematic sampling schemes. The DIDSON technology proved to be much more robust than the conventional split-beam sonar technology in enumerating pink salmon passage in September, when extremely high passage densities occurred in near-shore waters.

A post-season reassessment that included the DIDSON data resulted in a total Mission passage estimate of 16,152,000 pink salmon, which was very similar to the estimate of 15,658,000 fish obtained by subtracting all catch seaward of Mission (3,842,000 pinks) from the total run size of 19,500,000 pinks adopted in-season by the Panel.

*ii. Mid-channel sampling experiment under SEF*

As a continuation of a Southern Boundary Restoration and Enhancement Fund project initiated in 2009, a mid-channel sampling experiment was conducted in August of 2009 near the Mission site. The purpose of the study was to improve the accuracy and precision of daily salmon estimation in the offshore area[23]. A fishing vessel was chartered for 20 days. Two split-beam transducers were deployed to collect data from both sides of the vessel using a spatial sampling scheme that involved partitioning the transducer pitch angles to sample the water column. A Biosonics DTX-4 digital split-beam echosounder was employed, which allowed for easy access to the raw echo data and permitted flexible post-processing of the data to track fish.

*iii. Single-beam estimation*

Data were also collected using the traditional single-beam hydroacoustic system on the vessel that transected the river. Estimates using the single and split-beam data collected from the vessel were compared in-season. The two estimates showed consistent trends throughout the season.

*iv. Dealing with offshore target recognition uncertainty during the Early Stuart migration*

2009 was one of the few years that hydroacoustic methods were used to estimate Early Stuart abundance at Mission. The sampling program started in late June when the river carried large amounts of debris and the magnitude of daily salmon passage was very low. Since the majority of salmon migrated in offshore waters, they were sampled together with the acoustic noise (caused by debris) by the mobile split-beam sonar on the transecting vessel. A week into the sampling program, many of the targets acquired from the mobile sonar were found to be non-fish targets. To minimize positive bias due to target recognition error, a target strength (i.e., acoustic size of the target) filter was applied to the mobile data to estimate the proportion of fish targets in the total detected targets. This procedure was implemented for the remainder of the season.

[23] Xie, Y., F.J. Martens and A.P. Gray. 2010. A feasibility study on using a stationary hydroacoustic sub-sampling method to estimate offshore fish flux in the lower Fraser River: A project report to Southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. February, 2010.

*v. In-season data exchange with DFO's Qualark Hydroacoustic site and comparison of estimates*

2009 was the second consecutive season that DFO operated an in-season hydroacoustic monitoring site using DIDSON systems at Qualark Creek (95 km upstream from Mission). PSC and DFO staff at the Mission and Qualark sites exchanged daily salmon estimates beginning in mid-July. By the end of the season, regular information exchanges occurred 2-3 times each week. This timely exchange of information between the two sites greatly enhanced Staff confidence in the in-season estimates of sockeye salmon passage in 2009. Estimates of daily salmon passage at the PSC Mission site and DFO Qualark site were compared in-season and found to be consistent prior to the heavy in-river migration of pink salmon in late August. During pink-dominated periods in September, estimates of daily salmon at the two sites tracked each other very well. For this time period, Qualark estimated a total of 6.5 million salmon while Mission estimated a total of 5.1 million. However, according to historical data, fewer than 50% of the pink salmon that passed Mission would be expected to migrate as far as Qualark. This in-season comparison between the two sites therefore indicated that pink salmon passage at Mission had been significantly underestimated by the split-beam estimator. Detailed examinations of the split-beam data indicated that the system was unable to enumerate the near-shore (within 20 m) passage when the hourly passage rate reached 5,000 fish per hour. Staff compared left-bank near-shore salmon passage estimates in September over a common sounding range of 20 m from both the split-beam and DIDSON transducers. We found that the split-beam system accounted for only 1/5 (20%) of the salmon passages estimated by the DIDSON. A post-season estimate of daily salmon passage that incorporates the DIDSON data in the estimation procedure was completed. As a result of the findings in 2009, we will incorporate DIDSON data in our post-season estimates in future years.

*vi. Stratification of daily salmon abundance across the river for the purpose of estimating sockeye salmon flux using species composition derived from test fishing and fish-wheel catches*

LGL requested stratified daily salmon flux across the river at the Mission site, which Staff provided. Based on these data, LGL devised an alternative sockeye estimation method based on stratifying the species composition into the inshore and offshore regions.

**Stock Identification**

PSC staff conduct programs designed to identify the stock proportions of Fraser River sockeye and pink salmon in commercial, test, First Nations and recreational catches. Coupled with abundance indices from stock monitoring programs, these data provide information on the abundance and timing of sockeye and pink salmon as they migrate to their natal rivers in the Fraser watershed. Stock identification data are also used to account for Fraser sockeye and pink salmon wherever they are caught, and to apportion the daily estimates of sockeye escapement past Mission into discrete stock groups. Stock identification methods for sockeye salmon in 2009 used DNA and scale pattern analyses from fish caught in marine and in-river fisheries. 2009 was the second year that stock identification for pink salmon relied on DNA analyses rather than the protein electrophoretic techniques used previously.

**A. Sockeye Salmon**

Stock identification methods for sockeye salmon used DNA[24] and scale pattern analyses[25] for fish caught in marine and in-river fisheries. Such methods involve comparing the attributes of individuals in mixture samples (e.g., from mixed-stock fisheries) to the attributes of pure samples obtained from the spawning grounds of each of the named stocks (i.e., "standards" or "baselines"). Other attributes such as fish size and the presence of various parasitic organisms can also be used.

[24] Beacham, T.D., M. Lapointe, J.R. Candy, B. McIntosh, C. MacConnachie, A. Tabata, K. Kaukinen, L. Deng, K.M. Miller and R.E. Withler. 2004. Stock identification of Fraser River sockeye salmon using microsatellites and major histocompatibility complex variation. Trans. Am. Fish. Soc. 133: 1117-1137.

[25] Gable, J. and S. Cox-Rogers. Stock identification of Fraser River sockeye salmon: methodology and management application. PSC Tech. Rep. No. 5, October, 1993.

Samples from test fishery catches were analyzed daily, beginning in late June and continuing through late September. PSC staff sampled sockeye in test fishery catches and commercial fishery landings. Sampling locations included Port Renfrew and Vancouver in British Columbia, and Bellingham and Sekiu in Washington. The Alaska Department of Fish and Game (ADFG) collected samples for the PSC from District 104 purse seine landings in Ketchikan and Petersburg, whereas the PSC purchased services to obtain samples from District 104 landings in Prince Rupert. Langara Fishing Adventures provided samples from recreational catches near the Queen Charlotte Islands. DFO provided samples from Johnstone Strait test fisheries, and DFO and First Nations personnel obtained samples from Fraser River First Nations catches when available.

Proportions of Fraser River sockeye in District 104 seine catches were estimated by scale and DNA analyses in 2009. Sockeye catches in District 104 increased at the end of July, prompting a preliminary in-season DNA analysis. The proportion of Fraser sockeye detected in this sample was less than 5%, so regular scale analyses were performed in the post-season in conjunction with analysis of a small number of DNA samples from each week's catch. Post-season estimates of Fraser sockeye caught in District 104 totalled 13,000 in 2009, 12% of the total purse seine sockeye catch there.

Other than those collected in District 104, in-season commercial sockeye samples were limited to landings of sockeye caught incidentally in pink-directed Treaty Indian fisheries in Areas 7 and 7A on August 30 and September 3. Overall, commercial catches accounted for 2% of all sockeye samples analyzed for stock composition. Larger numbers of analyses were performed on samples from research programs (such as the Qualark test fishery and Crescent Island fish wheel) and First Nations FSC catches, but test fisheries accounted for more than 80% of the samples analyzed. Areas 12 and 20 constituted the majority of test fishing samples analyzed.

Test fishing samples identified high proportions of Harrison River sockeye throughout much of the 2009 season. In other recent years of relatively high returns of Harrison River sockeye (2005 and 2007), proportions of age $3_1$ and $4_1$ scales were often considerably higher in Area 20 samples than in Area 12 samples. These sockeye ages are mostly attributable to populations that do not rear in lakes, such as Harrison Rapids and Widgeon Slough sockeye (although fair numbers of Lower Adams sockeye from the dominant brood line can return at age $3_1$). In 2009, over 3,000 readable scales from Area 12 comprised approximately 5%, 6% and 2% of these age classes in samples from the last half of July, first half of August and last half of August, respectively. In contrast, these age classes made up 21%, 22% and 16% of Area 20 scale samples collected from the same time periods. Among Fraser River sockeye populations (excluding non-Fraser fish), Harrison and Widgeon sockeye averaged 3% in Area 12 samples, with a maximum of 11% on August 5. Area 20 samples over the same period averaged 14% with over two thirds of the samples exceeding the 11% maximum observed in Area 12 samples. The five highest estimates of Harrison and Widgeon sockeye in Area 20 were 35% (July 25), 27% (July 29), 24% (July 14), 24% (August 5) and 23% (August 10).

The pattern described above in which Harrison and Widgeon $3_1$ fish were present in higher proportions in Area 20 than in Area 12 samples suggests that migration route and smoltification age are related, i.e., sub-1 adults demonstrate a greater tendency to migrate through Juan de Fuca Strait than do sockeye that reared in lakes prior to smolting. This pattern is reinforced by observations that 58% of adult Late Shuswap sockeye in Area 20 were age $3_1$ fish compared to 8% in Area 12. Considering the membership of Harrison, Widgeon and Late Shuswap sockeye in the Late-run management group (and the conservation concerns for this group), their relatively strong age $3_1$ returns in 2009 and some other recent years, and their potentially different vulnerability to Canadian and U.S. fishers (more $3_1$ migrants through Juan de Fuca Strait than Johnstone Strait), further investigation of the life histories of these sockeye is warranted.

**B. Pink Salmon**

From 1987 to 2005, protein electrophoretic analysis of allozymes in pink salmon tissues[26] was used to estimate the contribution of Fraser River pink salmon in mixed-stock fisheries, primarily in areas south of Cape Caution. Most of these electrophoretic analyses were conducted by the Genetics Unit at the Washington Department of Fish and Wildlife (WDFW). In 2006, the Molecular Genetics Laboratory at the Pacific Biological Station in Nanaimo was contracted by the PSC to analyze pink salmon tissue samples collected from numerous spawning grounds in B.C. and Washington. A preliminary pink salmon microsatellite DNA baseline was assembled in early 2007 with 14 microsatellite DNA loci. Simulation analyses indicated that estimates of Fraser River pink salmon contributions in mixed-stock fisheries were sufficiently accurate for in-season application. The pink DNA baseline was first used to estimate contributions of Fraser pinks in mixed-stock fisheries in 2007.

Pink salmon mixtures are apportioned into three components - Fraser, Canada South Coast (excluding Fraser) and Washington. The ability to accomplish this is based on a database of genetic information (i.e., baseline) from numerous stocks from each region. In 2009, the baseline comprised 31 pink salmon stocks from the three regions, as follows: (1) Fraser River – Fraser mainstem, Vedder, Harrison, Coquihalla, Thompson, Seton and Bridge River stocks; (2) Canada South Coast (Non-Fraser) – Quatse, Cluxewe, Wakeman, Adam, Kakweiken, Glendale, Heydon, Big Qualicum, Keogh, Quinsam, Puntledge, Squamish and Indian River stocks; and (3) Washington – Nooksack, Skagit, Stillaguamish, Snohomish, Green, Puyallup, Hamma Hamma, Duckabush, Dosewallips, Dungeness, and Nisqually River stocks. The stocks in this baseline represent most of the pink salmon production that could contribute to marine fishery catches where Fraser pinks are typically harvested.

During the 2009 in-season management period, opercular tissue samples from 100 pink salmon were collected weekly from specific areas. After laboratory analysis of the tissue samples, the data were analyzed using a computer program that was developed by ADFG (i.e., SPAM, or Statistical Program for Analyzing Mixtures). Stock composition estimates derived from these analyses were used primarily for assessing catch, migration route (diversion rate) and run size of Fraser pinks. DNA samples were collected in Canadian statistical Areas 12, 13 and 20, and U.S. Areas 7 and 7A from early August to early September.

Proportions of Fraser pinks in purse seine samples from Areas 12 and 13 increased from about 15% in early August to 70-80% by early September, and in Area 20 increased from 50% in early August to about 70% by early September. In U.S. Areas 7 and 7A, the contribution of Fraser pinks ranged from about 60% to 80% from late August to early September. The pattern of generally high contributions of Fraser pink salmon relative to other co-migrating pink salmon stocks was consistent with observations in prior years, although the proportion of Fraser pinks during their peak migration period was slightly lower than usual. This was a reflection of unusually high returns of several Canada South Coast (non-Fraser) and Washington pink salmon stocks, not of weakness in the return of Fraser pinks.

The number of stocks and loci in the DNA baseline will likely be expanded in the future to help increase the accuracy of stock composition estimates. In addition, other statistical models for analyzing the genetic data will be evaluated.

**Stock Assessment**

Assessment of total Fraser River sockeye abundance by stock group is primarily based on catch, effort, escapement and stock composition data. Commercial fishing was very restricted in 2009, so test fishing catch and CPUE data were used extensively for assessing abundance by stock group. These data are analysed using cumulative-normal, cumulative-passage-to-date and

[26] White, B.A. 1996. Genetic stock identification of Fraser River pink salmon: Methodology and management application. Pacific Salmon Comm. Tech. Rep. No. 7: 44p.

Bayesian models (Pacific Salmon Commission 1995[27], 1998[28]). The Cumulative Normal model compares the reconstructed daily migration pattern to ideal run-timing curves, assuming the run is normally distributed. The Cumulative Passage model compares the total run observed up to a particular date in the past to the total run size for those years. Based on the resulting regression equation and the in-season estimate for the run-to-date, an estimate for the total run size in the current year is obtained.

The Bayesian model uses a similar comparison technique as the Cumulative Normal model to compare the observed run to a hypothetical run following a normal distribution. In addition, the Bayesian model relies on pre-season forecasts of run size, run timing and spread. These pieces of prior information are incorporated within the Bayesian model through the use of prior probability distributions (priors). Essentially these priors indicate the range of values that are assumed plausible for the various model parameters, and depending on the shape of the prior probability distribution indicate which parameter values are assumed more plausible than others. For in-season assessment, priors for run size are determined by the distributions for the pre-season forecasts, while the priors for run timing and spread are determined by the pre-season timing estimates and examining historic values for run timing and spread. Theoretically, the Bayesian model should provide more stable estimates since it relies on both the current in-season data as well as the historical data, and is therefore not as easily influenced by fluctuating in-season CPUE data from test fisheries. Traditionally, the expansion lines used to extrapolate the estimated daily CPUE into daily abundance estimates have been assumed to be known without error. In 2009, informative priors were used for the expansion lines of Early Stuart and Early Summer-run sockeye based on historic estimates of expansion lines. Similar changes are expected for future assessments of Summer and Late-run sockeye.

Assessments of total Fraser River pink salmon in marine areas in 2009 were primarily based on data from the purse seine test fisheries. Escapements to the Strait of Georgia were estimated by expansion of CPUE data from purse seine test fisheries. The proportion of Fraser River pink salmon in these catches was initially estimated using pre-season projections of stock composition. These estimates were replaced in-season by direct estimates from DNA samples. Unlike Fraser sockeye, no in-season escapement estimates (i.e., Mission) have been available for Fraser pinks to be used within the Bayesian cumulative-normal model. This is due to challenges in obtaining reliable species composition estimates to apply to hydroacoustic data.

Figures 3a, b, c, d and e provide an overview of run-size estimates from the stock assessment models at various dates during the season (median and 80% probability interval). These estimates can be compared against the in-season run-size estimates officially adopted by the Panel and used for management purposes and against the final in-season run-size estimates (i.e., accounted catch plus Mission escapement). For Early Stuart sockeye, initial estimates overestimated the run size because of large amounts of small-target data (acoustic noise caused by debris in the river) included within the hydroacoustic data. On July 24, adjustments were made to remove these small targets from the hydroacoustic data, thereby lowering the run-size estimates. Especially for Early Summer and Summer-run sockeye stocks, there were large discrepancies between pre-season forecasts and in-season run-size estimates. Even before the peak of the run was observed, however, the in-season models adjusted the run-size estimates downward. For Summer-run sockeye it was several meetings before the official run-size was lowered to the same extent as the in-season estimates, due to a perceived risk of subsequent upward run-size fluctuations. For Fraser River pink salmon, in-season estimates of run size remained very uncertain because of the lack of escapement data.

[27] Pacific Salmon Commission. 1995. Pacific Salmon Commission run-size estimation procedures: An analysis of the 1994 shortfall in escapement of Late-run Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 6: 179 p.

[28] Pacific Salmon Commission. 1998. Report of the Fraser River Panel to the Pacific Salmon Commission on the 1995 Fraser River sockeye and pink salmon fishing season. Vancouver, B.C., 64 p.

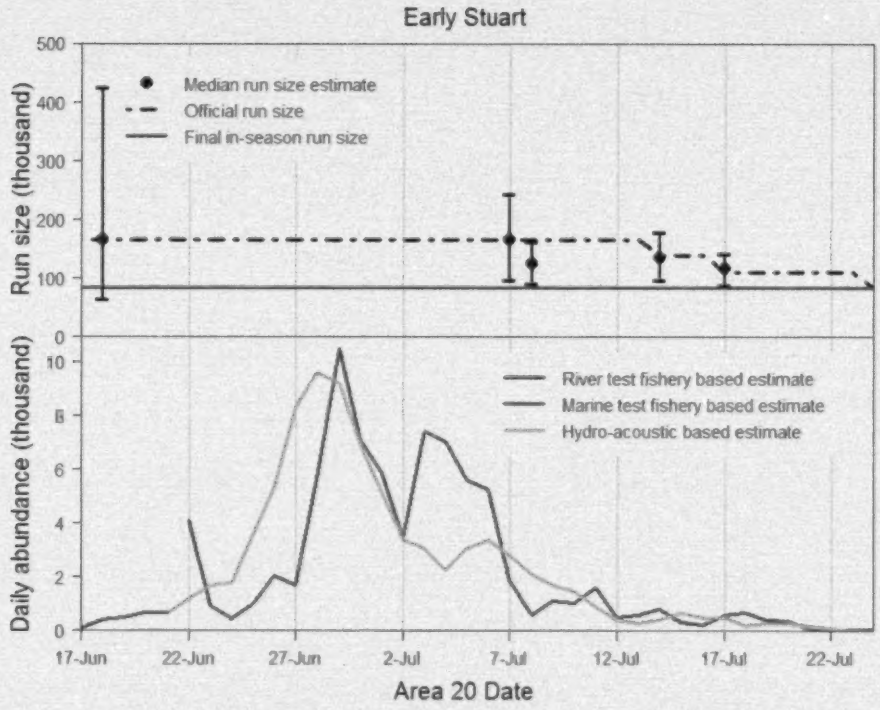


**Figure 16a**: Daily reconstructed abundance estimates for Early Stuart sockeye and corresponding run-size estimates at different times during the season.

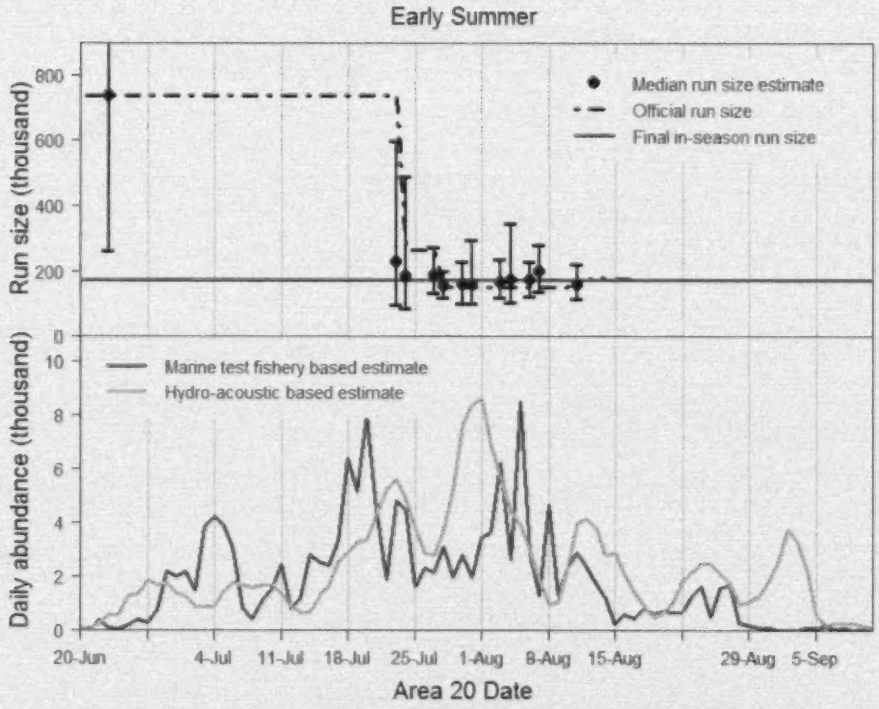


**Figure 3b**: Daily reconstructed abundance estimates for Early Summer-run sockeye and corresponding run-size estimates at different times during the season.

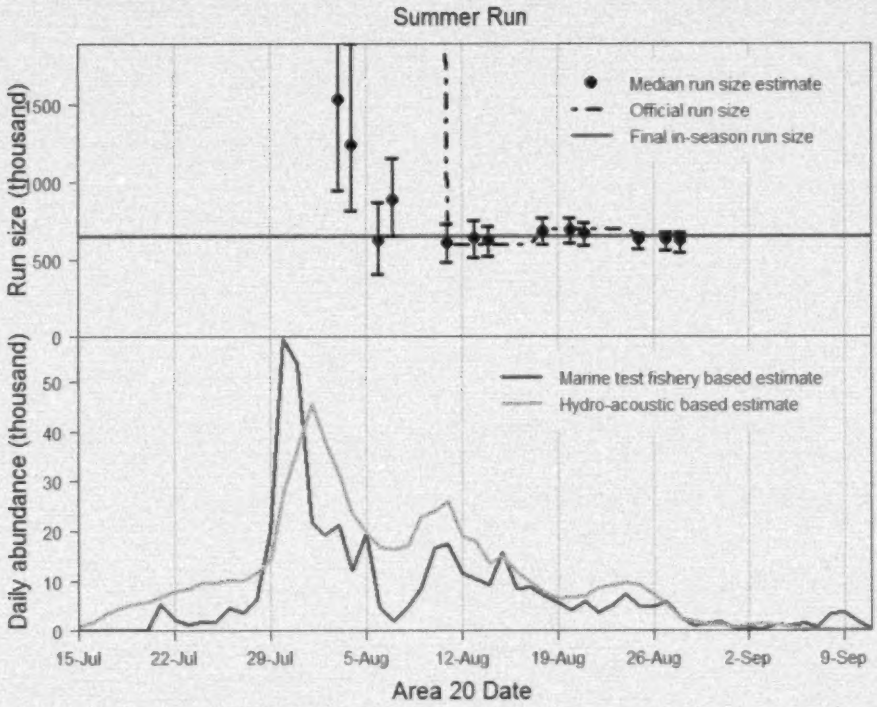


**Figure 3c**: Daily reconstructed abundance estimates for Summer-run sockeye and corresponding run-size estimates at different times during the season.

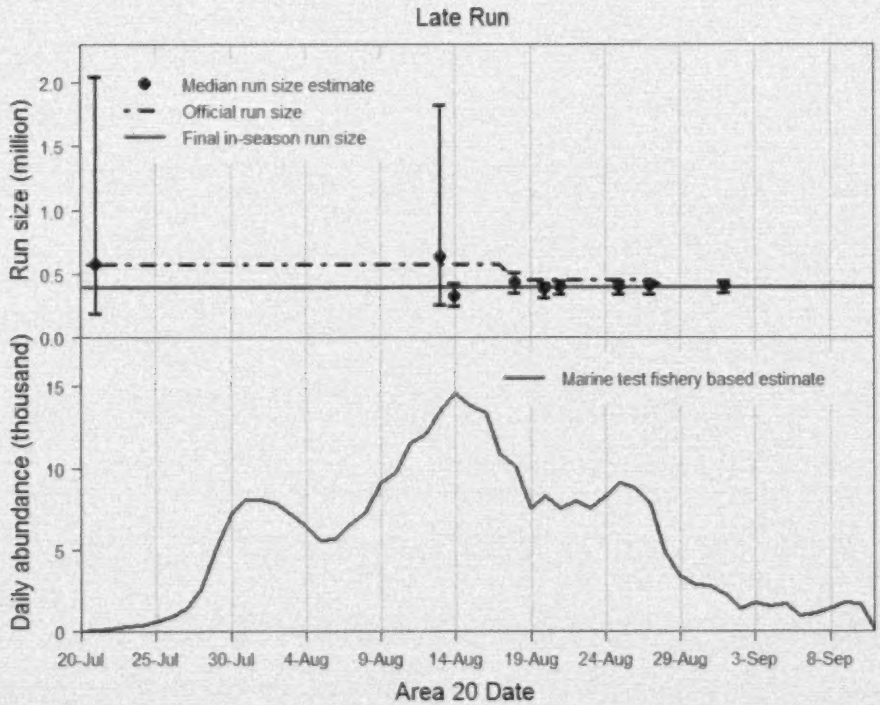


**Figure 3d**: Daily reconstructed abundance estimates for Late-run sockeye and corresponding run-size estimates at different times during the season.

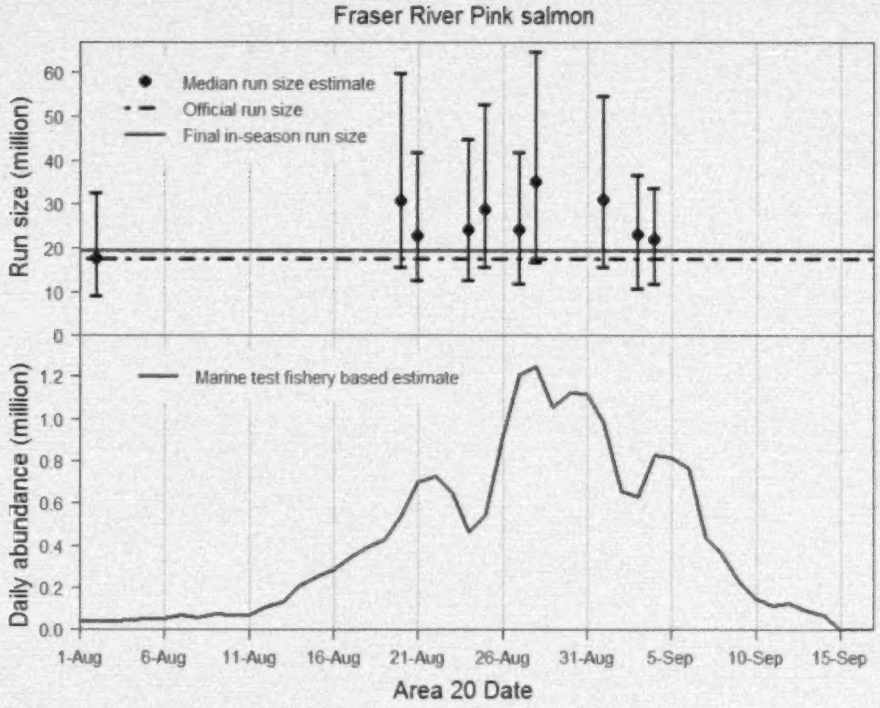


**Figure 3e**: Daily reconstructed abundance estimates for Fraser pink salmon and corresponding run-size estimates at different times during the season.

## APPENDIX H: HISTORICAL CATCH, ESCAPEMENT AND PRODUCTION DATA, AND DETAILED 2009 TAC CALCULATION

**Table 1.** Catch by user group, spawning escapement, Run-size Adjustment (RSA) and abundance of Fraser River sockeye salmon for cycle years 1997-2009.

| | Fraser Sockeye Salmon | | | |
|---|---|---|---|---|
| | **1997** | **2001** | **2005** | **2009** |
| CANADIAN CATCH | 9,724,000 | 1,196,900 | 1,142,600 | 73,800 |
| Commercial Catch | 8,435,000 | 297,400 | 129,400 | 0 |
| Panel Area | 1,593,000 | 132,500 | 3,400 | 0 |
| Non-Panel Areas | 6,842,000 | 164,900 | 126,000 | 0 |
| First Nations Catch | 1,196,000 | 847,600 | 956,200 | 71,800 |
| Marine FSC | 121,000 | 183,800 | 266,600 | 9,900 |
| Fraser River FSC | 1,075,000 | 489,000 | 684,200 | 61,900 |
| Economic Opportunity | 0 | 174,900 | 5,500 | 0 |
| Non-commercial Catch | 93,000 | 51,900 | 57,000 | 2,000 |
| Marine Recreational | 17,000 | 3,200 | 7,000 | 0 |
| Fraser Recreational | 58,000 | 34,000 | 42,600 | 0 |
| Charter | 18,000 | 11,700 | 700 | 2,000 |
| ESSR | 0 | 3,000 | 6,600 | 0 |
| UNITED STATES CATCH | 1,559,000 | 284,000 | 495,300 | 17,200 |
| **Washington Total** | **1,337,000** | **241,300** | **201,000** | **4,300** |
| Commercial catch | 1,337,000 | 230,500 | 200,000 | 0 |
| Treaty Indian | 657,000 | 160,100 | 138,900 | 0 |
| Non-Indian | 680,000 | 70,400 | 61,200 | 0 |
| Non-commercial Catch | 0 | 10,800 | 1,000 | 4,300 |
| Ceremonial | 0 | 10,800 | 1,000 | 4,300 |
| Recreational | 0 | 0 | 0 | 0 |
| **Alaska** | **222,000** | **42,800** | **294,300** | **12,900** |
| TEST FISHING CATCH | 142,000 | 122,900 | 117,500 | 32,100 |
| **PSC (Panel Areas)** | **81,000** | **92,600** | **48,000** | **20,400** |
| Canada | 77,000 | 92,600 | 42,200 | 16,900 |
| United States | 4,000 | 0 | 5,800 | 3,500 |
| **Canada (non-Panel Areas)** | **61,000** | **30,300** | **69,500** | **11,700** |
| TOTAL RUN | 16,415,300 | 7,213,600 | 7,077,200 | 1,637,400 |
| Total Catch in All Fisheries | 11,425,000 | 1,603,900 | 1,755,500 | 123,200 |
| Adult Spawning Escapemer | 4,253,100 | 5,257,000 | 3,308,000 | 1,055,700 |
| Jack Spawning Escapement | 9,100 | 21,800 | 52,800 | 47,900 |
| Run-size Adjustment | 728,000 | 330,900 | 1,961,000 | 410,600 |

**Table 2.** Catch by user group, spawning escapement and abundance of Fraser River pink salmon for cycle years 2003-2009.

| | Fraser Pink Salmon | | | |
|---|---|---|---|---|
| | **2003** | **2005** | **2007** | **2009** |
| **CANADIAN CATCH** | **1,215,900** | **637,400** | **406,100** | **1,726,800** |
| **Commercial Catch** | **833,200** | **125,300** | **1,900** | **915,600** |
| Panel Area | 28,300 | 1,100 | 0 | 75,100 |
| Non-Panel Areas | 804,900 | 124,200 | 1,900 | 840,400 |
| **First Nations Catch** | **296,100** | **447,700** | **326,900** | **520,500** |
| Marine FSC | 0 | 182,500 | 5,900 | 10,500 |
| Fraser River FSC | 19,600 | 53,700 | 11,700 | 2,000 |
| Economic Opportunity | 276,500 | 211,500 | 309,300 | 508,000 |
| **Non-commercial Catch** | **86,600** | **64,400** | **77,200** | **290,800** |
| Marine Recreational | 77,000 | 47,000 | 59,200 | 38,600 |
| Fraser Recreational | 9,400 | 17,400 | 18,000 | 237,200 |
| Charter | 200 | 0 | 0 | 2,700 |
| ESSR | 0 | 0 | 0 | 12,300 |
| **UNITED STATES CATCH** | **810,700** | **338,400** | **395,100** | **2,815,600** |
| **Washington Total** | **810,700** | **338,400** | **395,100** | **2,815,600** |
| **Commercial catch** | **771,800** | **316,800** | **368,200** | **2,793,600** |
| Treaty Indian | 320,300 | 182,700 | 210,100 | 1,031,400 |
| Non-Indian | 451,500 | 134,100 | 158,100 | 1,762,200 |
| **Non-commercial Catch** | **38,900** | **21,600** | **26,900** | **22,000** |
| Ceremonial | 100 | 100 | 400 | 1,000 |
| Recreational | 38,900 | 21,500 | 26,500 | 21,000 |
| **Alaska** | **0** | **0** | **0** | **0** |
| **TEST FISHING CATCH** | **42,300** | **84,600** | **38,800** | **21,800** |
| **PSC (Panel Areas)** | **28,700** | **13,900** | **25,100** | **18,300** |
| Canada | 28,700 | 13,500 | 23,600 | 12,500 |
| United States | 0 | 500 | 1,600 | 5,800 |
| **Canada (non-Panel Areas)** | **13,600** | **70,700** | **13,700** | **3,500** |
| **TOTAL RUN** | **26,000,000** | **10,000,000** | **11,000,000** | **19,993,000** |
| Total Catch in All Fisheries | 2,069,000 | 1,060,400 | 839,900 | 4,564,200 |
| Adult Spawning Escapemer | 23,931,000 | 8,939,600 | 10,160,100 | 15,428,800 |

**Table 3.** Catches of Fraser River sockeye salmon in Canadian First Nations fisheries by area for cycle years 1997-2009.*

| Fishing Area | 1997 | 2001 | 2005 | 2009 |
|---|---|---|---|---|
| Fraser River | 1,075,200 | 663,700 | 690,000 | 61,900 |
| Fraser River Mainstem | 1,045,300 | 629,300 | 649,000 | 32,100 |
| Below Port Mann | 197,100 | 107,900 | 96,000 | 4,900 |
| Port Mann to Mission | 193,400 | 73,600 | 64,000 | 2,700 |
| Mission to Hope | 104,000 | 90,500 | 135,000 | 5,100 |
| Hope to Sawmill Cr. | 299,700 | 132,000 | 169,000 | 8,100 |
| Sawmill Cr. to Kelly Cr. | 191,000 | 185,400 | 163,000 | 7,400 |
| Kelly Creek to Prince Georg | 53,200 | 32,200 | 15,000 | 1,600 |
| Above Prince George | 6,900 | 7,700 | 7,000 | 2,300 |
| Tributaries | 29,900 | 34,400 | 41,000 | 29,800 |
| Harrison/Lillooet System | n/a | n/a | n/a | 925 |
| Thompson System | 200 | 1,100 | 9,000 | 1,600 |
| Chilcotin System | 15,600 | 18,700 | 26,000 | 20,200 |
| Nechako System | 1,900 | 5,500 | 1,000 | 2,800 |
| Stuart System | 12,200 | 9,100 | 5,000 | 4,300 |
| Marine Areas | 121,000 | 184,000 | 267,000 | 9,900 |

* Data supplied by DFO.

**Table 4.** Catches of Fraser River pink salmon in Canadian First Nations fisheries by area for cycle years 2003-2009.*

| Fishing Area | 2003 | 2005 | 2007 | 2009 |
|---|---|---|---|---|
| Fraser River | 293,200 | 263,500 | 321,100 | 510,000 |
| Fraser River Mainstem | 293,200 | 263,100 | 320,800 | 509,600 |
| Below Port Mann | 2,600 | 15,300 | 4,000 | 39,200 |
| Port Mann to Mission | 5,500 | 5,000 | 1,500 | 200 |
| Mission to Hope | 284,100 | 221,900 | 312,200 | 469,800 |
| Hope to Sawmill Cr. | 900 | 6,300 | 1,600 | 200 |
| Sawmill Cr. to Kelly Cr. | 0 | 14,600 | 1,300 | 200 |
| Kelly Creek to Prince Georg | 0 | 0 | 0 | 0 |
| Above Prince George | 0 | 0 | 0 | 0 |
| Tributaries | 0 | 400 | 200 | 300 |
| Harrison/Lillooet System | 0 | 0 | 0 | 0 |
| Thompson System | 0 | 400 | 100 | 0 |
| Chilcotin System | 0 | 0 | 200 | 300 |
| Nechako System | 0 | 0 | 0 | 0 |
| Stuart System | 0 | 0 | 0 | 0 |
| Marine Areas | 0 | 182,500 | 5,900 | 10,500 |

* Data supplied by DFO.

**Table 5.** Escapements of sockeye salmon to Fraser River spawning areas for cycle years 1997-2009.

| DISTRICT<br>Stock Group<br>Stream/Lake | Year<br>1997 | 2001 | 2005 | 2009 |
|---|---|---|---|---|
| NORTHEAST | | | | |
| Upper Bowron R. | 4,811 | 5,842 | 1,730 | 2,170 |
| STUART | | | | |
| Early Stuart | | | | |
| Driftwood R. | 29,639 | 15,684 | 15,911 | 8,292 |
| Takla L. Streams | 150,913 | 77,701 | 43,584 | 16,548 |
| Middle R. Streams | 51,281 | 39,262 | 22,961 | 9,871 |
| Trembleur L. Streams | 35,108 | 38,087 | 15,841 | 10,580 |
| Late Stuart | | | | |
| Kazchek Cr. | 6,746 | 5,607 | 1,557 | 1,271 |
| Kuzkwa Cr. | 107,560 | 15,926 | 13,681 | 4,109 |
| Middle R. | 281,472 | 131,505 | 72,228 | 28,831 |
| Tachie R. | 491,098 | 187,645 | 185,879 | 47,415 |
| Miscellaneous | 20,776 | 10,886 | 19,779 | 5,338 |
| NECHAKO | | | | |
| Nadina R. (Late) | 4,588 | 19,922 | 9,049 | 7,008 |
| Nadina Channel | 4,911 | 34,933 | 12,785 | 4,392 |
| Stellako R. | 55,357 | 151,409 | 175,299 | 27,541 |
| QUESNEL | | | | |
| Horsefly R. | 972,402 | 1,829,662 | 657,844 | 62,627 |
| Horsefly Channel | 0 | 0 | 0 | 8,162 |
| McKinley Cr. | 253,280 | 257,189 | 142,200 | 9,621 |
| Mitchell R. | 534,431 | 1,040,092 | 553,111 *1* | 46,065 |
| Miscellaneous | 98,539 | 383,977 | 94,226 | 22,925 |
| CHILCOTIN | | | | |
| Chilko R. & L. | 978,328 | 668,671 | 535,967 | 213,379 |
| Chilko Channel | 7,499 | 0 | 0 | 0 |
| Taseko L. | 325 | 1,000 | 520 | 40 |
| SETON-ANDERSON | | | | |
| Gates Cr. | 777 | 459 | 2,020 | 4,688 |
| Gates Channel | 5,721 | 12,462 | 13,130 | 5,190 |
| Portage Cr. | 9,766 | 3,150 | 12,082 | 1,773 |
| NORTH THOMPSON | | | | |
| North Thompson R. | 232 | 8,794 | 77,784 | 4,997 |
| Raft R. | 6,093 | 32,498 | 26,456 | 11,464 |
| Fennell Cr. | 9,000 | 5,721 | 4,220 | 1,170 |
| SOUTH THOMPSON | | | | |
| Early Summer-run | | | | |
| Scotch Cr. | 3,085 | 2,449 | 4,163 | 4,672 |
| Seymour R. | 2,254 | 6,892 | 3,590 | 5,164 |
| Upper Adams / Momich / Cayenne | 376 | 963 | 330 | 268 |
| Miscellaneous | 246 | 2,743 | 1,348 | 2,363 |
| Late-run | | | | |
| Adams R. | 925 | 3,142 | 12,423 | 16,057 |
| Little R. | 9 | 991 | 7,916 | 14,491 |
| Lower Shuswap R. | 138 | 196 | 382 | 598 |
| Miscellaneous | 0 | 529 | 392 | 1,335 |
| HARRISON-LILLOOET | | | | |
| Birkenhead R. | 50,202 | 44,450 | 53,546 | 53,977 |
| Big Silver Cr. & misc. Birk. types | 1,674 | 12,348 | 5,315 | 7,620 |
| Harrison R. | 1,418 | 15,309 | 388,605 | 307,210 |
| Weaver Cr. | 4,275 | 4,205 | 12,948 | 8,442 |
| Weaver Channel | 21,229 | 15,710 | 35,568 | 27,114 |
| LOWER FRASER | | | | |
| Nahatlatch R. & L. | 9,959 | 5,441 | 2,168 | 1,439 |
| Cultus L. | 88 | 515 | 193 *2* | 889 *2* |
| Upper Pitt R. | 35,798 | 131,481 | 62,047 | 31,034 |
| Chilliwack L./Dolly Varden Cr. | 773 | 30,272 | 3,407 | 5,587 |
| MISCELLANEOUS *3* | 32 | 1,263 | 3,765 | 1,986 |
| ADULTS | 4,253,134 | 5,256,983 | 3,307,950 | 1,055,713 |
| JACKS | 9,136 | 21,834 | 52,831 *2* | 47,890 |
| TOTAL NET ESCAPEMENT | 4,262,270 | 5,278,817 | 3,360,781 | 1,103,603 |

* Estimates are from DFO.

*1* Spawning ground estimates of escapement for Mitchell River and other Quesnel Lake tributaries were unavailable in 2005. Escapement was therefore indirectly estimated based on the relationship of escapement to the Horsefly River system relative to the brood year as a predictor of the total Quesnel Lake system escapement. The total escapement to non-enumerated stocks was calculated as the difference between the resulting Quesnel Lake system estimate and the total enumerated stocks in the are

*2* Cultus estimates include 81 adults and 68 jacks in 2005, and 184 adults and 98 jacks in 2009 removed for broodstock

*3* 'Miscellaneous' category includes fish from small stocks throughout the Fraser watershed.

**Table 6.** Fraser River pink salmon production for odd brood years 1961-2007 (return years 1963-2009).

| Brood Year (by) | Spawners Total (millions) (by) | Spawners Female (millions) (by) | Potential Egg Deposition (millions) (by) | Fry Production (millions) (by+1) | Adult Returns (Catch + Escapement) (millions) (by+2) | | % Survival Fresh Water | % Survival Marine | Average To Date |
|---|---|---|---|---|---|---|---|---|---|
| 1961 | 1.092 | 0.654 | 1,569 | 143.6 | 5.482 | | 9.2% | 3.8% | 3.8% |
| 1963 | 1.954 | 1.216 | 2,435 | 284.2 | 2.320 | | 11.7% | 0.8% | 2.3% |
| 1965 | 1.194 | 0.692 | 1,488 | 274.0 | 12.963 | | 18.4% | 4.7% | 3.1% |
| 1967 | 1.831 | 0.973 | 2,132 | 308.0 | 3.931 | | 14.4% | 1.3% | 2.7% |
| 1969 | 1.531 | 0.957 | 2,018 | 287.7 | 9.763 | | 14.3% | 3.4% | 2.8% |
| 1971 | 1.805 | 1.096 | 1,923 | 273.6 | 6.801 | | 14.2% | 2.5% | 2.8% |
| 1973 | 1.754 | 1.009 | 1,865 | 212.3 | 4.894 | | 11.4% | 2.3% | 2.7% |
| 1975 | 1.367 | 0.781 | 1,493 | 319.7 | 8.209 | | 21.4% | 2.6% | 2.7% |
| 1977 | 2.388 | 1.362 | 2,960 | 483.7 | 14.404 | | 16.3% | 3.0% | 2.7% |
| 1979 | 3.561 | 2.076 | 3,787 | 341.3 | 18.685 | | 9.0% | 5.5% | 3.0% |
| 1981 | 4.488 | 2.560 | 4,814 | 607.0 | 15.346 | | 12.6% | 2.5% | 2.9% |
| 1983 | 4.632 | 2.931 | 4,702 | 557.4 | 19.038 | | 11.9% | 3.4% | 3.0% |
| 1985 | 6.461 | 3.561 | 5,900 | 264.5 | 7.172 | | 4.5% | 2.7% | 3.0% |
| 1987 | 3.224 | 1.856 | 3,471 | 436.0 | 16.484 | | 12.6% | 3.8% | 3.0% |
| 1989 | 7.189 | 4.383 | 7,198 | 400.4 | 22.174 | | 5.6% | 5.5% | 3.2% |
| 1991 | 12.943 | 8.002 | 12,330 | 685.5 | 16.983 | | 5.6% | 2.5% | 3.1% |
| 1993 | 10.768 | 6.454 | 9,192 | 437.7 | 12.904 | | 4.8% | 2.9% | 3.1% |
| 1995 | 7.175 | 4.248 | 10,233 | 279.1 | 8.176 | | 2.7% | 2.9% | 3.1% |
| 1997 | 2.842 | 1.740 | 2,863 | 257.5 | 3.608 | | 9.0% | 1.4% | 3.0% |
| 1999 | 3.445 | 1.885 | 2,702 | 219.0 | 21.262 | | 8.1% | 9.7% | 3.4% |
| 2001 | 19.814 | 9.543 | 16,274 | 714.4 | 26.000 | *1* | 4.4% | 3.6% | 3.4% |
| 2003 | n/a | n/a | n/a | 419.0 | 10.000 | *1* | n/a | 2.4% | 3.3% |
| 2005 | n/a | n/a | n/a | 614.5 | 11.000 | *1* | n/a | 1.8% | 3.3% |
| 2007 | n/a | n/a | n/a | 497.0 | 19.993 | *2* | n/a | 4.0% | 3.3% |
| Average | 4.831 | 2.761 | 4,826 | 388.2 | 12.400 | | 10.6% | 3.3% | |

*1* Estimates of adult returns for in 2003, 2005 and 2007 (brood years 2001, 2003 and 2005) are highly uncertain because pink salmon escapement enumeration programs were not conducted by DFO. Instead, estimates of adult returns for these years are based on in-season abundance estimates by the PSC.

2 Beginning in 2009 (brood year 2007), the PSC hydroacoustic program provided estimates of daily in-river passage at Mission. Using these estimates, total return was estimated by summing total Mission passage and total catch below Mission, while spawning escapement was calculated by subtracting catch from run size.

**Table 7**. Detailed calculation of total allowable catch and international catch allocation for Fraser River sockeye (by management group) and pink salmon in 2009. Calculations are based on the in-season estimates of abundance, spawning escapement target and management adjustment at the time the Panel relinquished control of the last U.S Panel Area (October 3), in accordance with Annex IV of the Treaty and the February 15, 2008 Commission Guidance.

| TAC Calculations | Fraser Sockeye | | | | | | | Fraser Pinks | |
|---|---|---|---|---|---|---|---|---|---|
| | Early Stuart | Early Summer | Summer | Birken -head | Late | Total | | | |
| **RUN STATUS, ESCAPEMENT NEEDS & AVAILABLE SURPLUS** | | | | | | | | | |
| **In-season Abundance Estimate** | **85,000** | **175,000** | **650,000** | **60,000** | **400,000** | **1,370,000** | | **19,500,000** | |
| **Adjusted Spawning Escapement Target *** | **85,000** | **175,000** | **650,000** | **48,000** | **320,000** | **1,278,000** | | **6,000,000** | |
| Spawning Escapement Target (SET) | 85,000 | 175,000 | 520,000 | 48,000 | 320,000 | 1,148,000 | | 6,000,000 | |
| *%SET from TAM rules* | *100%* | *100%* | *80%* | *80%* | *80%* | | | 0 | |
| Management Adjustment (MA) | 32,300 | 105,000 | 145,600 | 0 | n/a | 282,900 | | n/a | |
| *Proportional MA (pMA)* | *0.38* | *0.6000* | *0.28* | *0* | *6.04* | | | | |
| **Test Fishing Catch (TF, post-seas. est.)** | **1,900** | **5,500** | **15,800** | **1,600** | **7,300** | **32,100** | | **21,800** | |
| **Surplus above Adjusted SET & TF** | **0** | **0** | **0** | **10,400** | **72,700** | **83,100** | | **13,478,200** | |
| **DEDUCTIONS & TAC FOR INTERNATIONAL SHARING** | | | | | | | | | |
| **Aboriginal Fishery Exemption (AFE) ** ** | **7,500** | **9,800** | **46,500** | **10,400** | **72,700** | **146,800** | | **n/a** | |
| **Total Deductions (Adj.SET + TF + AFE)** | **94,500** | **190,300** | **712,200** | **60,000** | **400,000** | **1,457,000** | | **6,021,800** | |
| **Available TAC (Abundance - Deductions)** | **0** | **0** | **0** | **0** | **0** | **0** | | **13,478,200** | |
| **UNITED STATES (Washington) TAC** | | | | | | | | | |
| **Propor. distrib. TAC - Payback** | **0** | **0** | **0** | **0** | **0** | **0** | | **3,463,900** | |
| Proportionally distributed TAC *** | 0 | 0 | 0 | 0 | 0 | 0 | 16.5% | 3,463,900 | 25.7% |
| U.S. Payback | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | |
| **Washington Catch** | **0** | **500** | **2,100** | **700** | **1,000** | **4,300** | | **2,815,600** | |
| **Deviation from TAC - Payback** | **0** | **-500** | **-2,100** | **-700** | **-1,000** | **-4,300** | | **648,300** | |
| **CANADIAN TAC** | | | | | | | | | |
| **Propor. distrib. TAC + Payback + AFE** | **7,500** | **9,800** | **46,500** | **10,400** | **72,700** | **146,800** | | **10,014,300** | |
| Propor. distrib. TAC + U.S. Payback | 0 | 0 | 0 | 0 | 0 | 0 | 83.5% | 10,014,300 | 74.3% |
| AFE | 7,500 | 9,800 | 46,500 | 10,400 | 72,700 | 146,800 | | 0 | |
| **Canadian Catch excluding ESSR Catch** | **7,600** | **10,100** | **47,800** | **1,600** | **6,800** | **73,800** | | **1,714,500** | |
| **Deviation from TAC + Payback + AFE** | **-100** | **-300** | **-1,300** | **8,800** | **65,900** | **73,100** | | **8,299,800** | |
| **TOTAL** | | | | | | | | | |
| **Available TAC + U.S. Payback + AFE** | **7,500** | **9,800** | **46,500** | **10,400** | **72,700** | **146,800** | | **13,478,200** | |
| **Total Catch** | **7,600** | **10,600** | **49,900** | **2,300** | **7,800** | **78,100** | | **4,530,100** | |
| **Deviation from TAC + U.S. Payback + AFE** | **-100** | **-800** | **-3,400** | **8,100** | **64,900** | **68,800** | | **8,948,100** | |

* The adjusted spawning escapement target cannot exceed the estimated abundance.

** The AFE was adjusted to account for the actual catch of Early Stuart sockeye.

*** Washington sockeye and pink shares according to Annex IV of the Pacific Salmon Treaty and Feb. 15, 2008, Commission Guidance.

## APPENDIX I: MEMBERS OF THE FRASER RIVER TECHNICAL COMMITTEE IN 2009

| Canada | United States |
|---|---|
| A. Huang, Co-Chair<br>*Fisheries and Oceans Canada* | G. Graves, Co-Chair<br>*Northwest Indian Fisheries Commission* |
| S. Grant<br>*Fisheries and Oceans Canada* | P. Busby<br>*National Marine Fisheries Service* |
| B. Pechter<br>*Fisheries and Oceans Canada* | |
| J. Scroggie<br>*Fisheries and Oceans Canada* | |
| M. Staley<br>*First Nations Advisor* | |

## APPENDIX J: STAFF OF THE PACIFIC SALMON COMMISSION IN 2009

### EXECUTIVE OFFICE

Don Kowal, Executive Secretary

Kimberly Bartlett, Secretary/Receptionist

Sandie Gibson, Information Technology Support Specialist

Kathy Mulholland, Information Technology Manager

Vicki Ryall, Meeting Planner

Teri Tarita, Records Administrator/Librarian

### FINANCE AND ADMINISTRATION

Ken Medlock, Controller

Bonnie Dalziel, Accountant

Angus Mackay, Manager, Restoration & Enhancement Funds

Victor Keong, Program Assistant, Restoration & Enhancement Funds

### FISHERIES MANAGEMENT DIVISION STAFF

Mike Lapointe, Chief Biologist

Catherine Michielsens, Quantitative Biologist

#### STOCK IDENTIFICATION GROUP

Ian Guthrie, Head

Holly Anozie, Assistant Scale Analyst (Acting)

Maxine Forrest, Senior Scale Analyst

Steve Latham, Sockeye Stock Identification Biologist

Julie Sellars, Senior Scale Analyst (Acting)

Zac Semeniuk, Resource Management Technician

Brian Wells, Scale Lab Assistant (Term)

Bruce White, Pink Stock Identification Biologist

#### STOCK MONITORING GROUP

Jim Cave, Head

Keith Forrest, Test Fishing Biologist

Andrew Gray, Hydroacoustics Biologist

Fiona Martens, Hydroacoustic Technician

Jacqueline Nelitz, Hydroacoustic Technician

Yunbo Xie, Hydroacoustics Scientist